FCC CertificationTest Report

Miragii, LLC
Miragii Necklace
Model: MIRAGII-N-A

FCC ID:2AEUB-M1

REPORT# **15WB0430004F-01 Rev 0**
20 June, 2015

Prepared for:

Miragii, LLC

16885 West Bernardo Drive, Suite 320, San Diego, CA USA

Prepared by:

WASHINGTON TECHNOLOGY INTERNATIONAL LIMITED

This report applies only to the sample evaluated prior to the preparation date stated above.

This report must be copied in its entirety, including all technical documents.

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For the

Miragii, LLC

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Model: MIRAGII-N-A

FCC ID:2AEUB-M1

WLL REPORT# **15WB0430004F-01 Rev 0**
20 June, 2015

Prepared by:

Henry Guo

Henry guo

Reviewed by:

Steven Yang

Steven yang

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Abstract

This report has been prepared on behalf of Miragii, LLC to support the attached Application for Equipment Authorization. The test report and application are submitted for a Spread Spectrum Transceiver under Part 15.247 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for Miragii, LLC

The above equipment was tested by A Test Lab Techno Corp.Taiwan Accreditation Foundation accreditation number: 1330

And the tested byShenzhen Academy of Metrology and Quality Inspection.The FCC Registration Number is806614

The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2009 and KDB 558074,and the energy emitted by the sample tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247 .The test results of this report relate only to the tested sample identified in this report.

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Miragii Necklace is a Bluetooth V3.0 compliant device andcomplieswiththelimitsforaDirectSequenceSpreadSpectrumTransmitterdevice under Part 15.247 of the FCC Rules and Regulations.

Revision History	Reason	Date
Rev 0	Initial Release	June 20, 2015

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1 Introduction

1.1 Compliance Statement

After the modifications listed in Section 2.5 were installed:

Miragii, LLCMiragiiNecklacecomplies with the limits for a Spread Spectrum Transceiver device under Part 15.247 of the FCC Rules and Regulations.

1.2 Test Scope Summary

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2009 version of ANSI C63.10

Standard FCC 15.207&FCC15.247	Item	Result	Remark
15.207	AC Power Conducted Emission	PASS	-----
15.247(b)(1)	Max. Output Power	PASS	-----
15.247(c)	Transmitter Radiated Emissions	PASS	-----
15.247(a)(1)	20dB RF Bandwidth	PASS	-----
15.247(a)(1)(iii)	Carrier Frequency Separation	PASS	-----
15.247(a)(1)(iii)	Number of Hopping	PASS	-----
15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	PASS	-----
15.247(c)	Out of Band ConductedSpurious Emission	PASS	-----
15.247(c)	Band Edge Measurement	PASS	-----
15.247(c)	Occupied Bandwidth Measurement	PASS	-----
15.203	Antenna Requirement	PASS	-----

The test results of this report relate only to the tested sample(s) identified in this report. Manufacturer or whom it may concern should recognize the pass or fail of the test result.

NOTE: The EUT is also considered as a kind of other class B digital device it has been verified to comply with the requirements of FCC Part 15B Class B (Verification) the test report has been issued by WTIL.

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1.3 Contract Information

Customer: Miragii, LLC

16885 West Bernardo Drive, Suite 320, San Diego, CA USA

1.4 Test and Support Personnel

Murphy WangA Test Lab Techno Corp.

No. 140-1, Changan Street, Bade City,
Taoyuan County 334, Taiwan R.O.C.

Peter LinShenzhen Academy of Metrology and Quality Inspection

No.4 TongFa Road, Xili Town Nanshan
District, Shenzhen, China

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1.5 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**eres
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**c**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**B**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**m**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

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2 Equipment Under Test

2.1 EUT Identification

The results obtained relate only to the item(s) tested.

Table 1: Overview of Miragii Necklace, Equipment Under Test

Product	Miragii Necklace	
Trade Name	Miragii	
Model Number	Miragii-N-A	
Applicant	Miragii, LLC 16885 West Bernardo Drive, Suite 320, San Diego, CA USA	
FCC ID	2AEUB-M1	
Frequency Range	2402 ~ 2480 MHz	
Modulation Type	Bluetooth 3.0+EDR	GFSK for 1Mbps
		8DPSK for 3Mbps
Antenna Type	Sheet Metal Antenna	
Antenna Gain	0.5dBi	
RF Output Power (Conducted)	BT3.0 GFSK for 1Mbps 2.523 dBm / 1.786 mW BT3.0 8DPSK for 3Mbps 0.583 dBm / 1.143 mW	
20dB Bandwidth	BT 3.0 GFSK: 1.242MHz BT3.0 8DPSK: 1.384MHz	

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2.2 Test Methodology

2.2.1 Mode of Operation

Decision of Test ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Normal Working Mode
Mode 2: GFSK Link Mode
Mode 3: π/4-DQPSK Link Mode
Mode 4: 8DPSK Link Mode
--

By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “X axis” position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

Note: We only show worse data with GFSK Link Mode and 8DPSK Link Mode in this report.

2.2.2 EUT Exercise Software

1	Setup the EUT as shown on 2.3
2	Turn on the power of all EUT.
3	Keep EUT in continuous transmitting under the help of PC software CSR BlueTest3.

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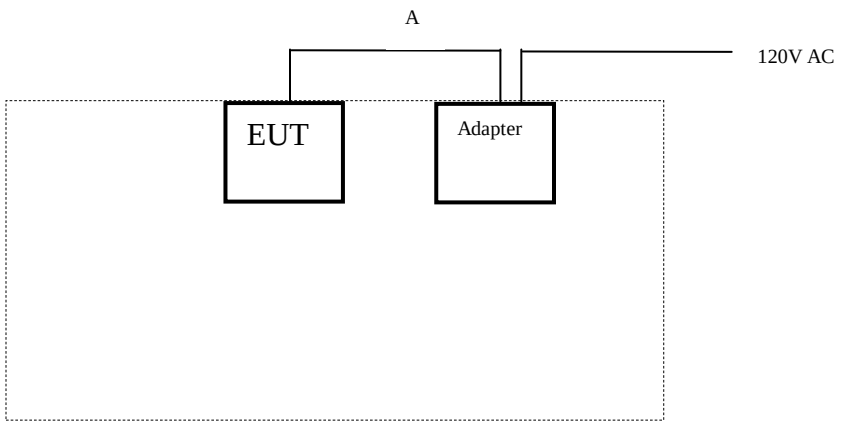
2.3 Test Configuration

Miragii, LLCMiragii Necklace, Equipment Under Test (EUT), was operated from 5VDCfrom adapter.

The EUT firmware/software was set up to control power, bit rate, and channel selection.



Signal Cable Type		Signal Cable Description
A	USB Power Cable	Non-Shielded, 0.3m

Figure 1: Test Configuration

Auxiliary equipmentdescription				
Product		Manufacturer	Model Number	S/N
(1)	Power Adapter	Sony	--	3513W51304150
--	--	--	--	--

2.4 Test Site Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	26
Humidity (%RH)	25-75	60
Barometric pressure (mbar)	860-1060	950

2.5 EUT Modifications

N/A

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2.6 Test Location

Site 1:

A Test Lab Techno Corp.

No. 140-1, Changan Street, Bade City,

Taoyuan County 334, Taiwan R.O.C.

Tel：+886-3-2710188 / Fax：+886-3-2710190

Taiwan Accreditation Foundation accreditation number: 1330

http://www.atl-lab.com.tw/e-index.htm

Site 2:

Shenzhen Academy of Metrology and Quality Inspection

No.4 TongFa Road, Xili Town Nanshan District, Shenzhen, China

2.7 Measurements

2.7.1 *Measurement Method*

All measurements were performed according to the 2009 version of ANSI C63.10 for testing compliance of a wide variety of unlicensed wireless devices

2.7.2 *Measurement Uncertainty*

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + ...}$$

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where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$div_{a, b, c}$ = the individual uncertainty element divisor based on the probability distribution

divisor = 1.732 for rectangular distribution

divisor = 2 for normal distribution

divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

where U = expanded uncertainty

k = coverage factor

k ≤ 2 for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 2below.

Table 2: Expanded Uncertainty List

Test Item	Frequency Range	Uncertainty (dB)
Conducted Emission	9kHz ~ 30MHz	3.50
Radiated Emission	30MHz ~ 1000MHz	4.50
	1000MHz ~ 18000MHz	4.60
	18000MHz ~ 40000MHz	5.12

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3 Test Equipment

Table3showsalistof the test equipment used for measurementsalong with the calibration information.

Table 3: Test Equipment List

Conducted Emission

Describe	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
SB3319	EMI Test Receiver	Rohde & Schwarz	ESCS30	Jan.20,2015	1 Year
SB4357	AMN	Rohde & Schwarz	ENV216	Jan.20,2015	1 Year

Radiated Emission

3 Meter Chamber					
Model No.	Equipment	Manufacturer	Serial Number	Cal. Date	Remark
ESU40	EMI Test Receiver	R&S	SB8501/09	Jan.20, 2015	1 Year
VULB9163	Bilog Antenna	Schwarzbeck	SB8501/04	Jan.20, 2015	1 Year
HF906	Horn Antenna	R&S	SB3435	Jan.20, 2015	1 Year
--	Amplifier(1-18GHz)	R&S	SB3435/01	Jan.20, 2015	1 Year
--	Amplifier(18-40GHz)	R&S	SB3435/02	Jan.20, 2015	1 Year
AT4560	Horn Antenna	Amplifier Research	SB5392/02	Jan.20, 2015	1 Year
9X6X6	3m Semi-anechoic chamber	Albatross Projects	SB3450/01	Oct.12, 2013	2 Years
ESI26	EMI Test Receiver	Rohde & Schwarz	SB3436	Jan.20,2015	1 Year
VULB9163	Broadband antenna	SCHWARZBECK	SB3955	Jan.20,2015	1 Year
HF907	Horn Antenna	R&S	SB8501/01	Aug.15,2014	1 Year

Remark: (1)Calibration period 1 year. (2)Calibration period 2 years. (3) Calibration period 3 years.

Note: N.C.R. = No Calibration Request

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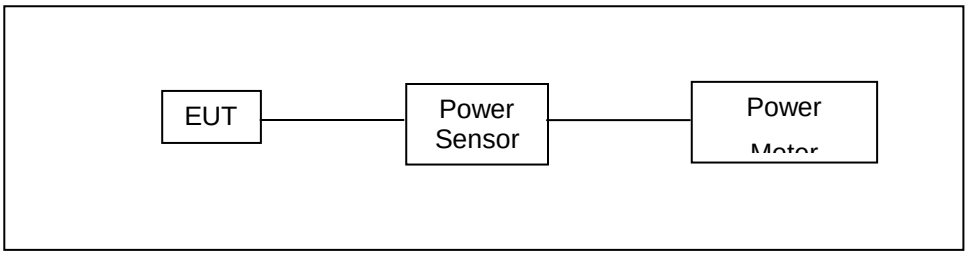
4 Maximum Conducted Output Power Measurement

4.1 Limit

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

4.2 Test Setup



4.3 Test Instruments

Describe	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Single Channel PK Power Sensor	Agilent	N1911A	MY45101619	Dec.21, 2014	1Year
Wideband Power Meter	Agilent	N1921A	MY45241957	Dec.21, 2014	1Year

4.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The tests below are run with the EUT's transmitter set at high power in TX mode. The EUT is needed to force selection of output power level and channel number. While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to power sensor. The maximum peak output power shall not exceed 1 watt.

Use a direct connection between the antenna port of transmitter and the power sensor, for prevent the power sensor input attenuation 40-50 dB. Set the RBW Bandwidth of the emission or use a channel power meter mode.

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm). For antennas with gains greater than 6 dBi, transmitter output level must be decreased by an amount equal to (GAIN - 6)/3 dBm.

The antenna port of the EUT was connected to the input of a power sensor. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

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4.5 Test Result

Model Number	MIRAGII-N-A			
Test Item	Maximum Conducted Output Power			
Test Mode	Mode 2 Link Mode			
Date of Test	2015/05/26			
Modulation technology	Frequency (MHz)	Peak Power		Limit (mW)
		(dBm)	(mW)	
GFSK	2402	-0.563	0.879	<1000
	2441	2.523	1.786	
	2480	2.047	1.603	

Model Number	MIRAGII-N-A			
Test Item	Maximum Conducted Output Power0			
Test Mode	Mode 4Link Mode			
Date of Test	2015/05/26			
Modulation technology	Frequency (MHz)	Peak Power		Limit (mW)
		(dBm)	(mW)	
8DPSK	2402	-2.011	0.630	<125
	2441	0.583	1.143	
	2480	0.124	1.028	

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5 Conducted Emission Measurement

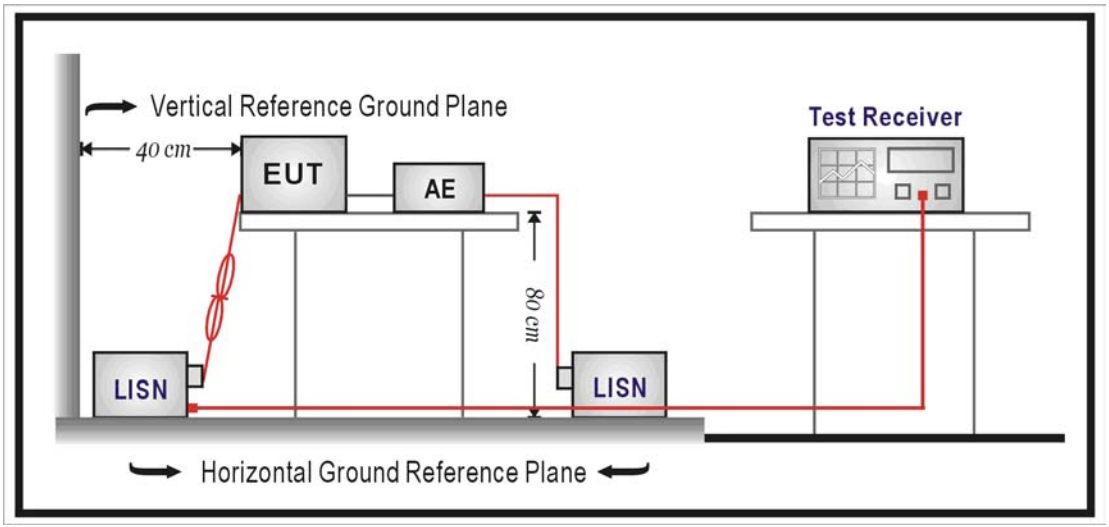
5.1 Limit

Frequency (MHz)	Quasi-peak	Average
0.15 - 0.5	**66 to 56**	**56 to 46**
0.50 - 5.0	**56**	**46**
5.0 - 30.0	**60**	**50**

5.2 Test Instruments

Describe	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
SB3319	EMI Test Receiver	Rohde & Schwarz	ESCS30	Jan.20,2015	1 Year
SB4357	AMN	Rohde & Schwarz	ENV216	Jan.20,2015	1 Year

5.3 Test Setup



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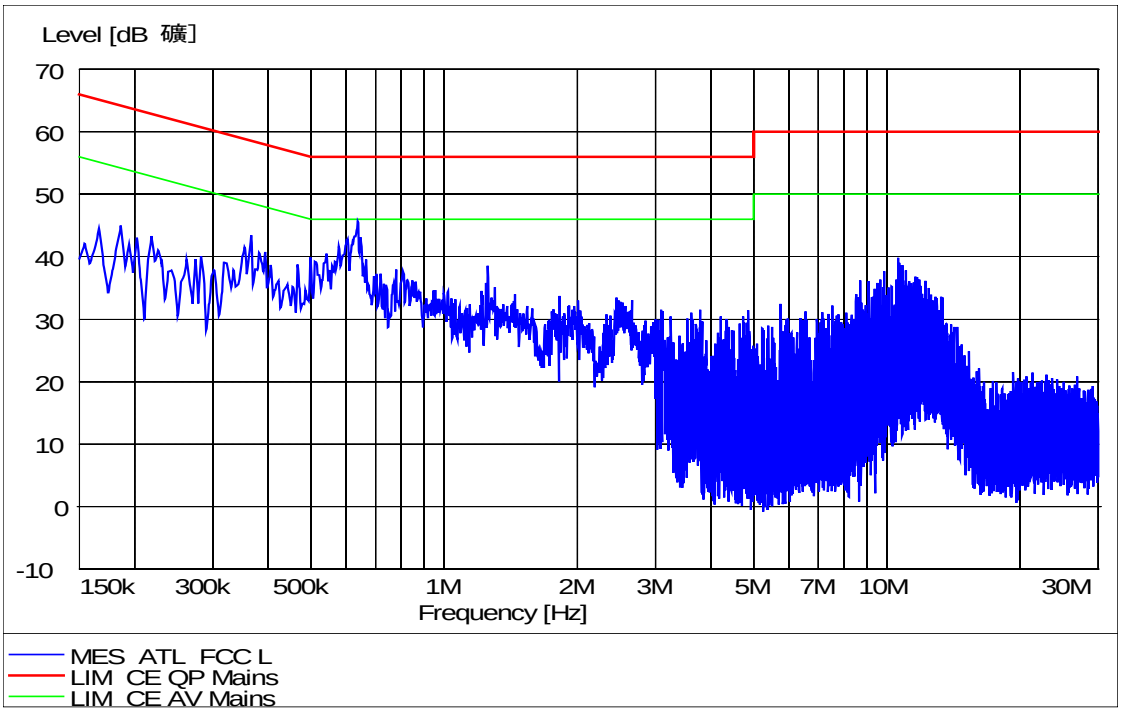
5.4 Test Result

Standard:	FCC 15.107	Line:	L1
Test item:	Conducted Emission	Power:	AC 120V/60Hz
Model Number:	MIRAGII-N-A	Temp.(℃)/Hum.(%RH):	18(℃)/50%RH
Mode:	2	Date:	2015/06/10
		Test By:	Fly Lu
Description:	L line		



Frequency (MHz)	QP(dBμV)		Ave.(dBμV)	
	Level	Limit	Level	Limit
0.186	35.2	64.2	18.3	54.2
0.218	34.1	62.9	21.6	52.9
0.366	34.4	58.6	19.3	48.6
0.606	36.7	56.0	20.8	46.0
0.638	38.4	56.0	22.5	46.0
1.254	27.9	56.0	16.8	46.0

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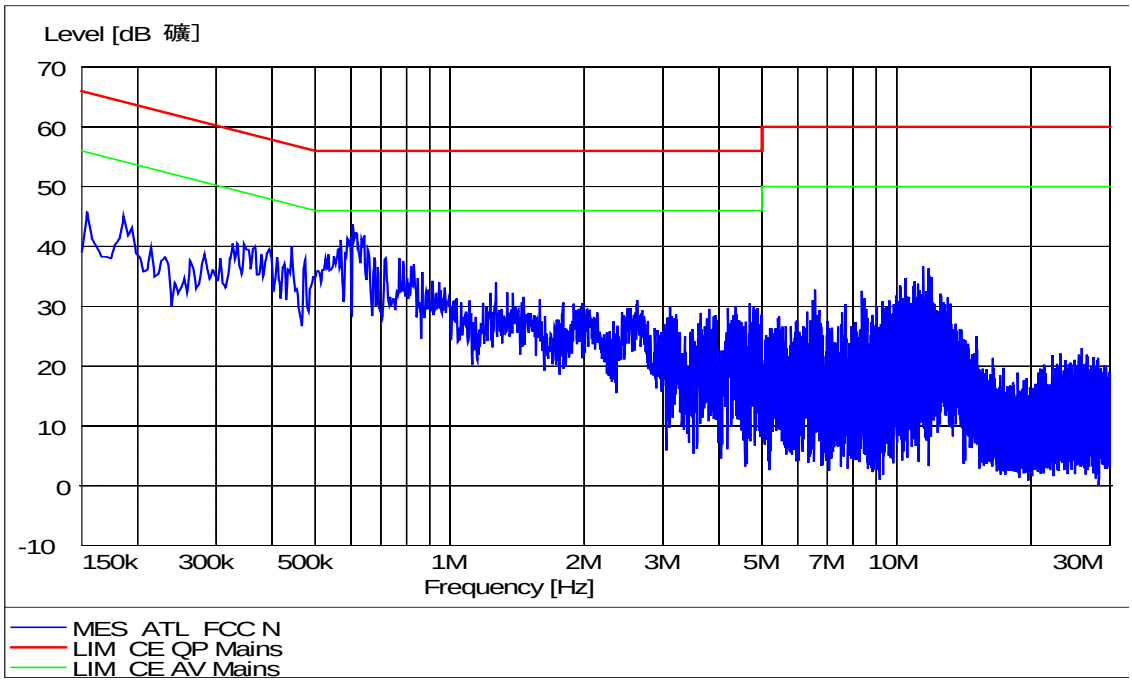
Standard:	FCC 15.207	Line:	N
Test item:	Conducted Emission	Power:	AC 120V/60Hz
Model Number:	MIRAGII-N-A	Temp.(℃)/Hum.(%RH):	18(℃)/50%RH
Mode:	2	Date:	2015/06/10
		Test By:	Fly Lu
Description:	N line		



Frequency (MHz)	QP(dBμV)		Ave.(dBμV)	
	Level	Limit	Level	Limit
0.154	36.2	65.8	17.3	55.8
0.186	34.6	64.2	18.3	54.2
0.442	29.3	57.0	16.8	47.0
0.570	34.7	56.0	18.7	46.0
0.606	35.4	56.0	21.3	46.0
0.770	29.5	56.0	18.1	46.0

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6 Radiated Interference Measurement

6.1 Limit

According to §15.209(a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shallnot exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (µV/m at meter)	Measurement Distance (meters)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / F (kHz)	30
1.705 – 30.0	30	30
30 - 88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequencybands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operationwithin these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

6.2 Test Instruments

3 Meter Chamber					
Model No.	Equipment	Manufacturer	Serial Number	Cal. Date	Remark
ESU40	EMI Test Receiver	R&S	SB8501/09	Jan.20, 2015	1 Year
VULB9163	Bilog Antenna	Schwarzbeck	SB8501/04	Jan.20, 2015	1 Year
HF906	Horn Antenna	R&S	SB3435	Jan.20, 2015	1 Year
--	Amplifier(1-18GHz)	R&S	SB3435/01	Jan.20, 2015	1 Year
--	Amplifier(18-40GHz)	R&S	SB3435/02	Jan.20, 2015	1 Year
AT4560	Horn Antenna	Amplifier Research	SB5392/02	Jan.20, 2015	1 Year
9X6X6	3m Semi-anechoic chamber	Albatross Projects	SB3450/01	Oct.12, 2013	2 Years
ESI26	EMI Test Receiver	Rohde & Schwarz	SB3436	Jan.20,2015	1 Year
VULB9163	Broadband antenna	SCHWARZBECK	SB3955	Jan.20,2015	1 Year
HF907	Horn Antenna	R&S	SB8501/01	Aug.15,2014	1 Year
Spectrum Analyzer	Agilent	N9039A	MY46520256	Jan.10, 2015	2 Years

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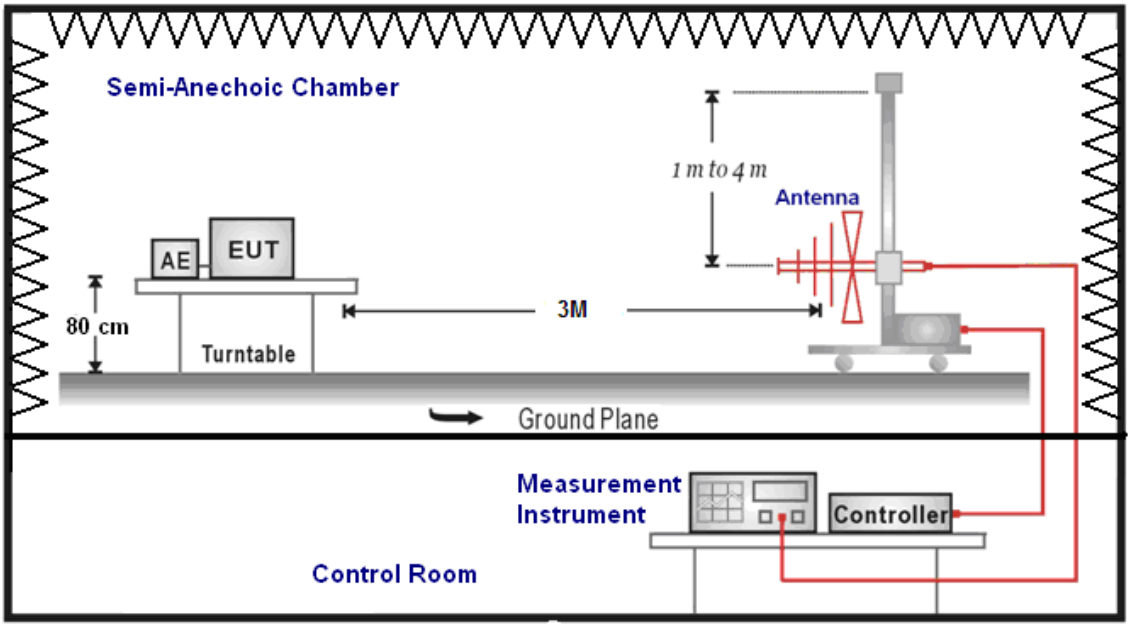
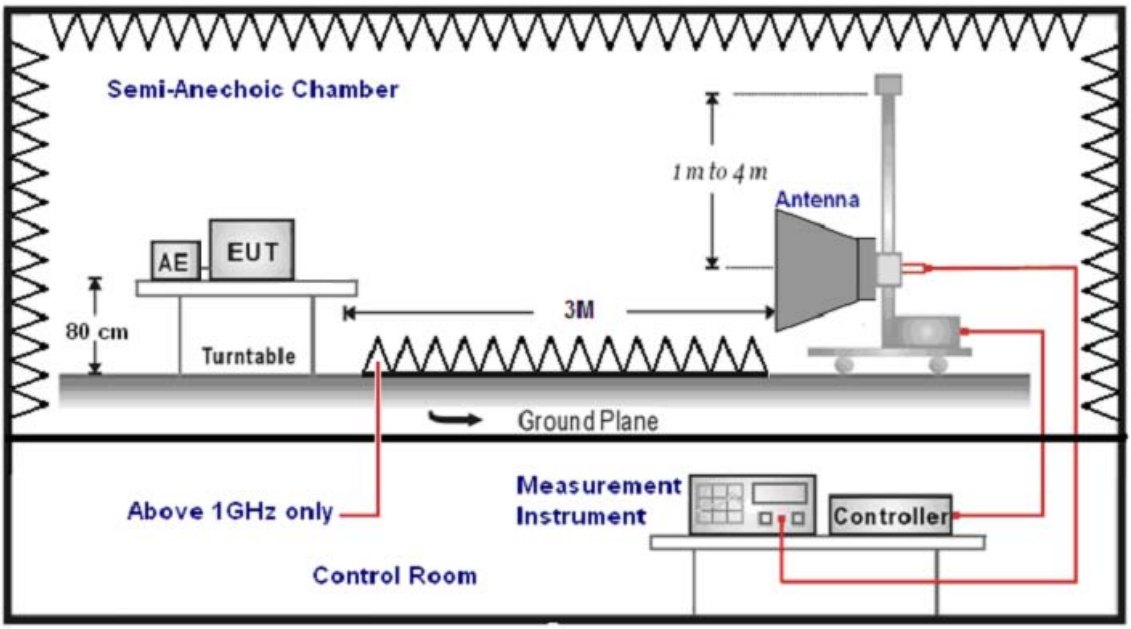
6.3 Setup

Below 1GHz



Above 1GHz



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6.4 Test Procedure

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 250 MHz to 2.5 GHz in order to cover the whole spectrum below10th harmonic which could generate from the EUT. During the test,EUT was set to transmit continuously &Measurementsspectrumrange from 9kHz to 26.5 GHz is investigated.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detectionmeasurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unlessotherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is setto 1 MHz for peak measurements and 10 Hz for average measurements.

A nonconductive material surrounded the EUT to supporting the EUT for standing on tree orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

Biconilog Antenna (mode VULB9163) at 3 Meter and Horn antenna was used in frequencies 1 – 18 GHz at a distance of 3 meter while 18-40GHz at distance of 1 meter. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20dB/decade).

For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower thanaverage limit (that means the emission level in peak mode also complies with the limit in averagemode), then testing will be stopped and peak values of EUT will be reported, otherwise, theemissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtractingthe duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in micro volts pre meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro colts per meter (dBuV/m).

The actual field is intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

(1) Amplitude (dBuV/m) = FI (dBuV) +AF (dBuV) +CL (dBuV)-Gain (dB)

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

(2) Actual Amplitude (dBuV/m) = Amplitude (dBuV)-Dis(dB)

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

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(a) For fundamental frequency : Transmitter Output < +30dBm

(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

Data of measurement within this frequency range without mark in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

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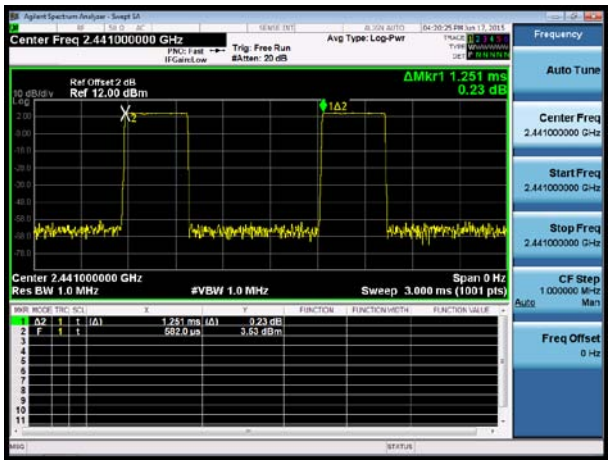
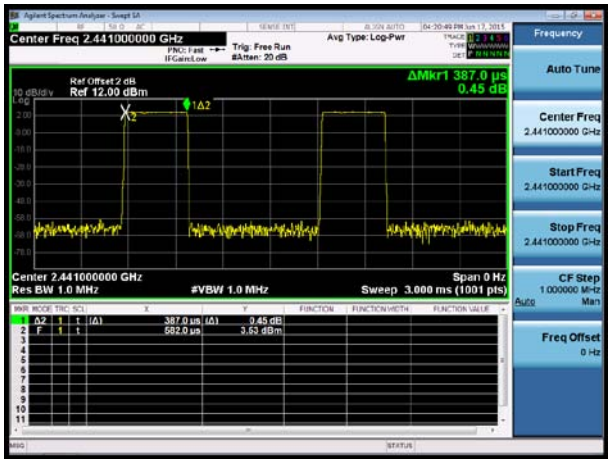
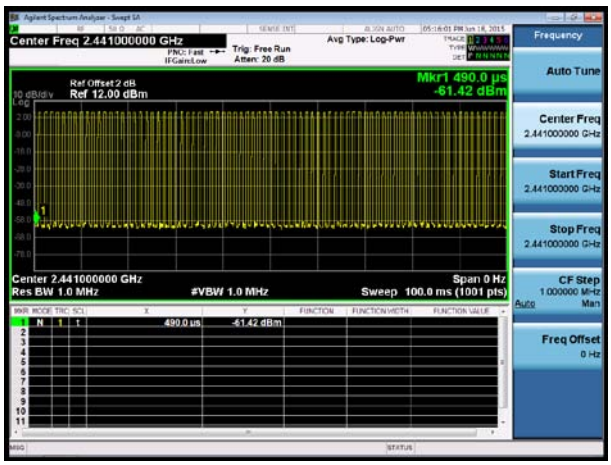
Note:The duty cycle factor for calculate average level is 10.19 dB, and average limit is 20 dB blowe peak limit, so if peak measured level comply with average limit, the average level was deemed to comply with average limit.

Duty cycle(ms)=Ton/T=0.387/1.251*100%=30.94%

Duty cycle factor=20log (1/duty cycle)=10.19







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6.5 Test Result

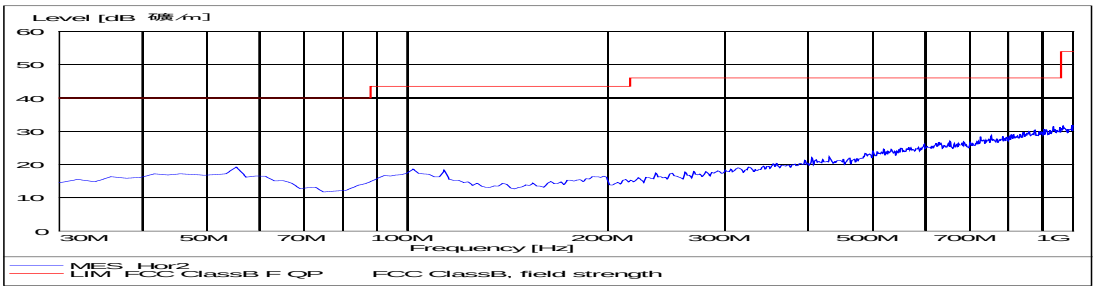
Below 1GHz

Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	AC 120V/60HZ
Model Number:	MIRAGII-N-A	Temp.(℃)/Hum.(%RH):	26(℃)/60%RH
Mode:	Mode 2	Date:	2015/05/21
		Test By:	Fly Lu

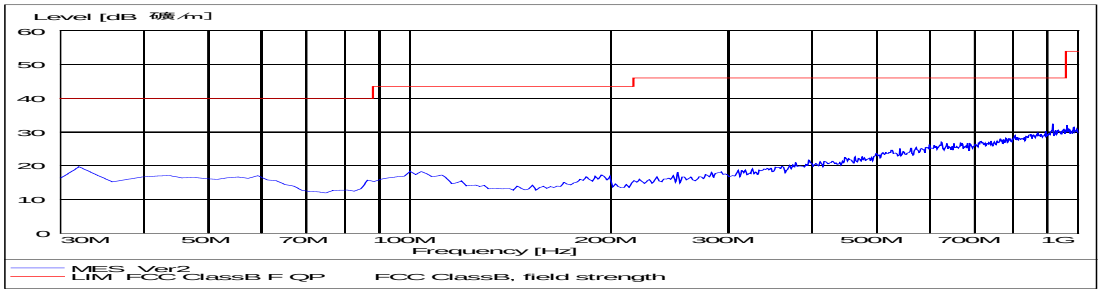
Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dB)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
148.40	3.83	13.07	16.9	43.5	26.6	QP	H
457.04	7.09	12.53	19.62	43.5	23.88	QP	H
192.81	9.56	11.51	21.07	43.5	22.43	QP	H
205.22	5.05	12.44	17.49	43.5	26.01	QP	H
537.69	2.76	21.08	23.84	46.0	22.16	QP	H
667.80	3.73	22.93	26.66	46.0	19.34	QP	H
37.69	9.43	16.41	25.84	40.0	14.16	QP	V
108.21	7.21	13.70	20.91	43.5	22.59	QP	V
132.79	5.86	14.24	20.1	43.5	23.4	QP	V
166.63	8.71	12.17	20.88	43.5	22.62	QP	V
174.45	8.09	11.71	19.8	43.5	23.7	QP	V
255.59	4.86	15.14	20	46.0	26	QP	V

Note: No emission found between lowest internal used/generated frequencies to 30MHz (9 kHz~30MHz).

Horizontal



Vertical



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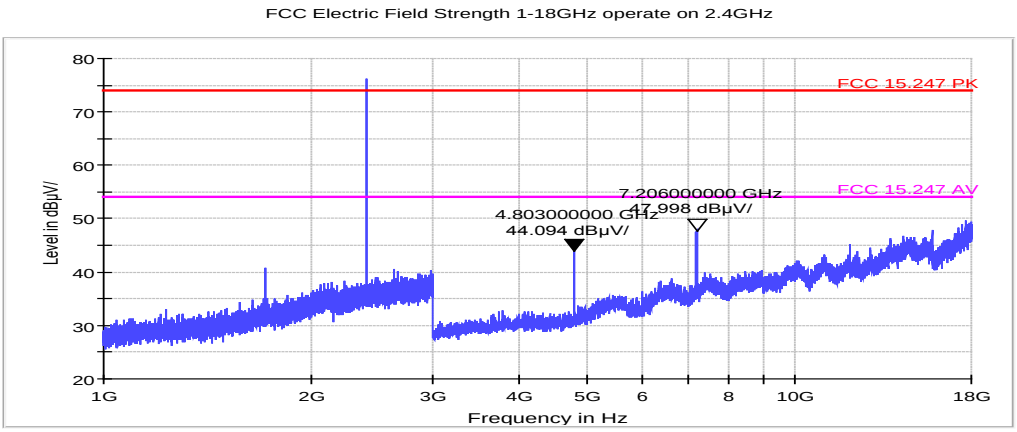
Above 1GHz

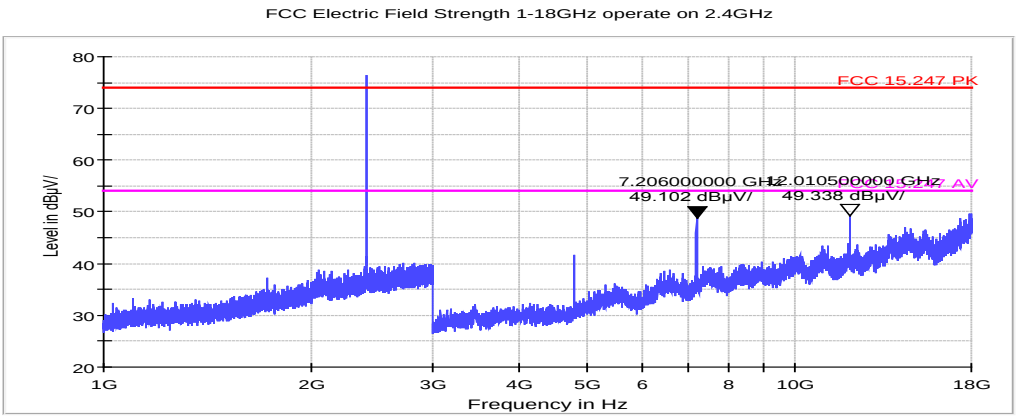
Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	AC 120V/60HZ
Model Number:	MIRAGII-N-A	Temp.(℃)/Hum.(%RH):	26(℃)/60%RH
Mode:	Mode 2	Date:	2015/05/21
Frequency:	2402 MHz	Test By:	Fly Lu

Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
4803	38.29	5.8	44.09	74.0	29.91	peak	H
7206	41.20	6.8	48.00	74.0	26.00	peak	H
4803	36.35	5.8	42.15	74.0	31.85	peak	V
7206	42.30	6.8	49.10	74.0	24.90	peak	V

Horizontal



Vertical



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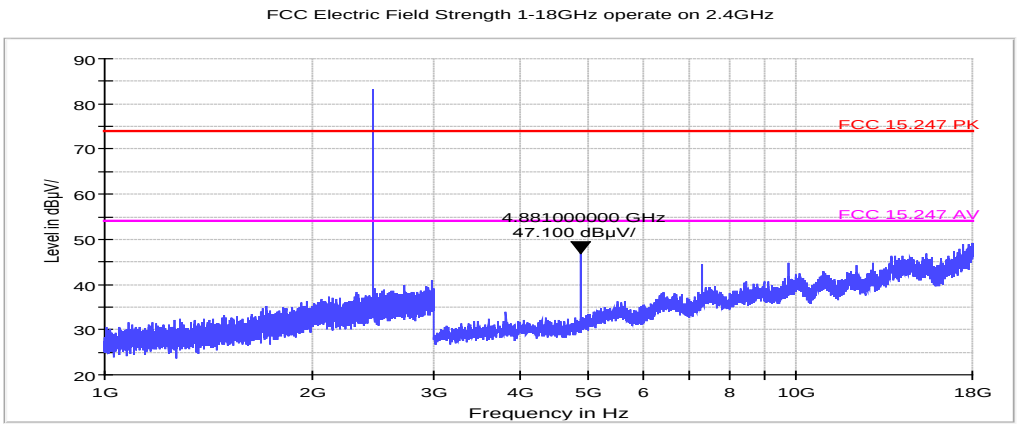
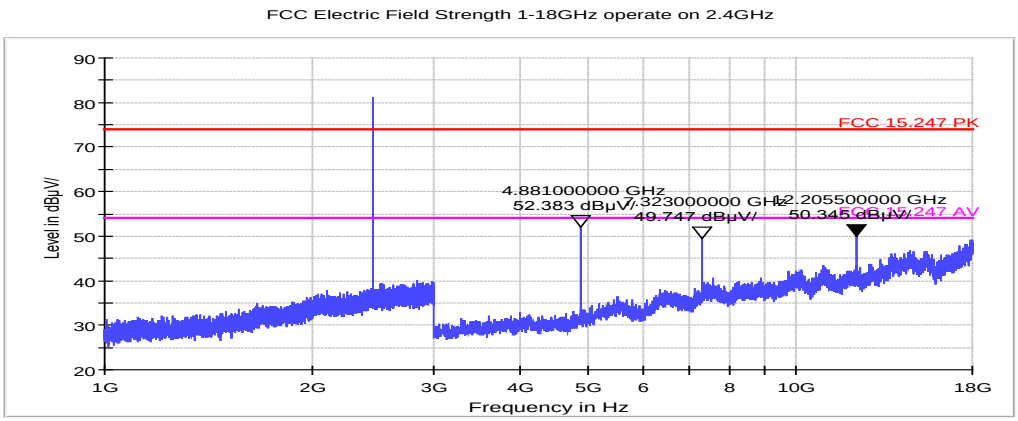
Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	AC 120V/60HZ
Model Number:	MIRAGII-N-A	Temp.(℃)/Hum.(%RH):	26(℃)/60%RH
Mode:	Mode 2	Date:	2015/05/21
Frequency:	2441 MHz	Test By:	Fly Lu

Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
4881	41.20	5.9	47.10	74.0	26.90	peak	H
7323	38.12	6.8	44.92	74.0	29.08	peak	H
4881	46.48	5.9	52.38	74.0	21.62	peak	V
7323	42.95	6.8	49.75	74.0	24.25	peak	V

Horizontal



Vertical



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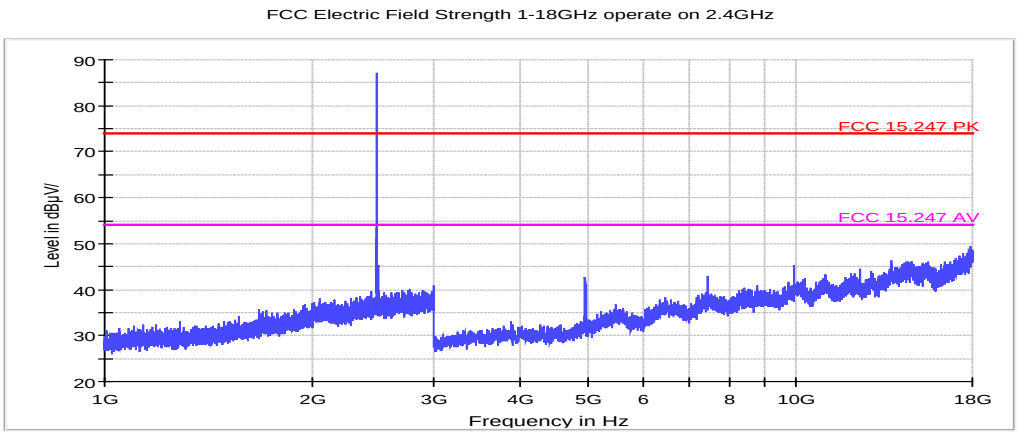
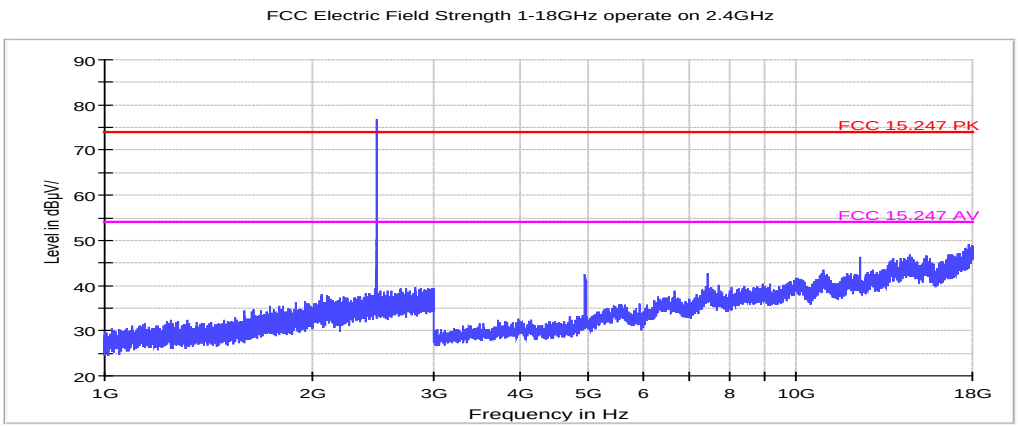
Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	AC 120V/60HZ
Model Number:	MIRAGII-N-A	Temp.(℃)/Hum.(%RH):	26(℃)/60%RH
Mode:	Mode 2	Date:	2015/05/21
Frequency:	2480 MHz	Test By:	Fly Lu

Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
4960	37.99	5.9	43.89	74.0	30.11	peak	H
7440	35.75	6.8	42.55	74.0	31.45	peak	H
4960	38.04	5.9	43.94	74.0	30.06	peak	V
7440	35.46	6.8	42.26	74.0	31.74	peak	V

Horizontal



Vertical



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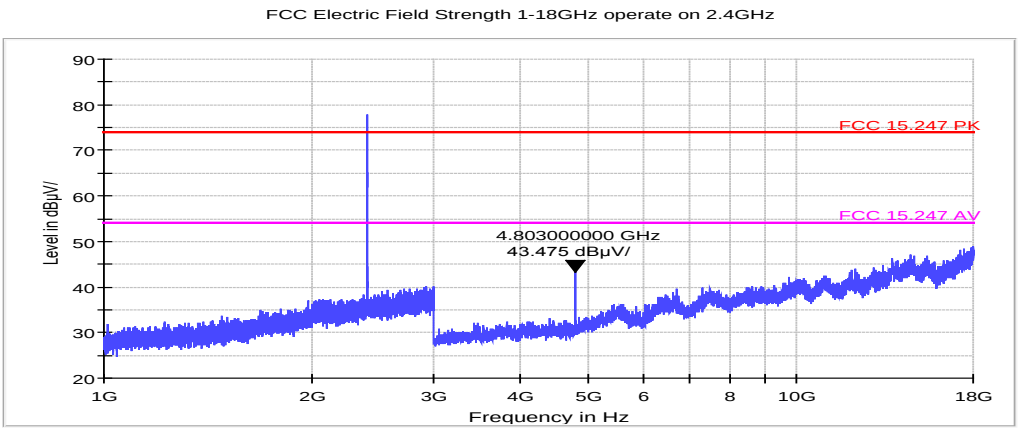
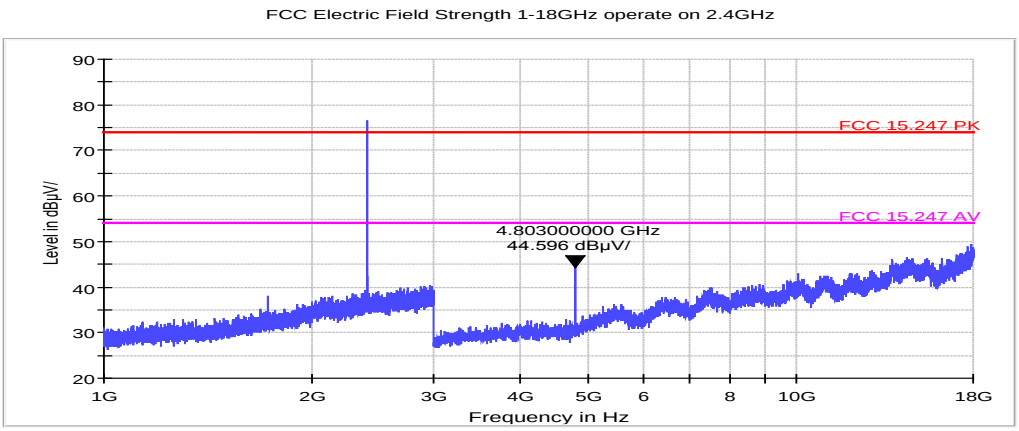
Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	AC 120V/60HZ
Model Number:	MIRAGII-N-A	Temp.(℃)/Hum.(%RH):	26(℃)/60%RH
Mode:	Mode 4	Date:	2015/05/21
Frequency:	2402 MHz	Test By:	Fly Lu

Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
4803	37.68	5.8	43.48	74.0	30.52	peak	H
7206	32.25	6.8	39.05	74.0	34.95	peak	H
4803	38.80	5.8	44.60	74.0	29.40	peak	V
7206	31.89	6.8	38.69	74.0	35.31	peak	V

Horizontal



Vertical



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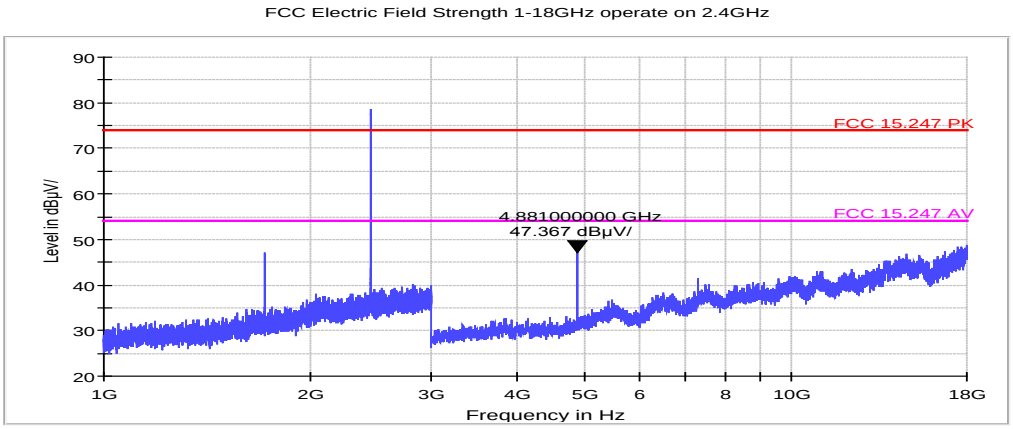
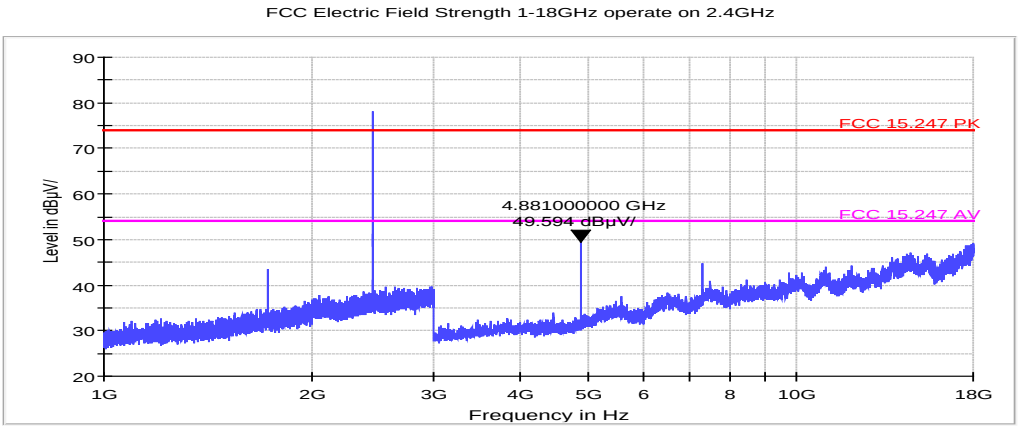
Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	AC 120V/60HZ
Model Number:	MIRAGII-N-A	Temp.(℃)/Hum.(%RH):	26(℃)/60%RH
Mode:	Mode 4	Date:	2015/05/21
Frequency:	2441 MHz	Test By:	Fly Lu

Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
4881	41.58	5.9	47.38	74.0	26.62	peak	H
7323	35.86	6.8	42.66	74.0	31.34	peak	H
4882	43.79	5.9	49.59	74.0	24.41	peak	V
7323	32.46	6.8	39.26	74.0	34.74	peak	V

Horizontal



Vertical



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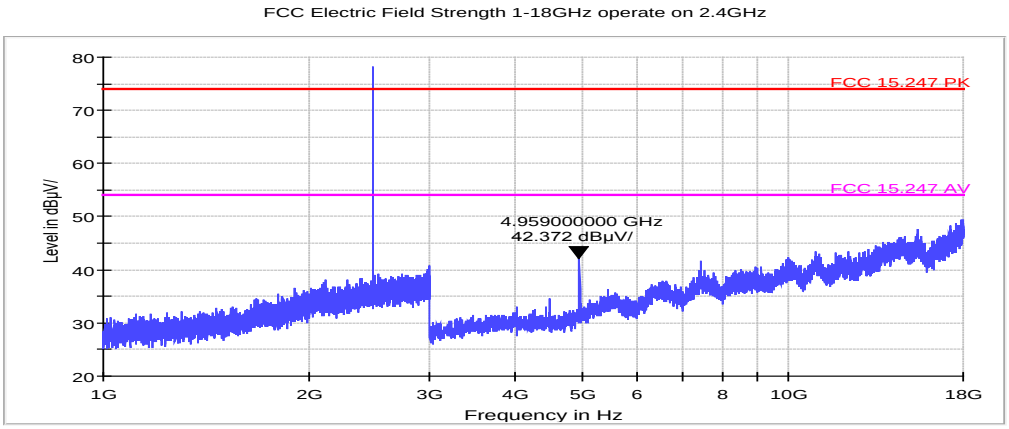
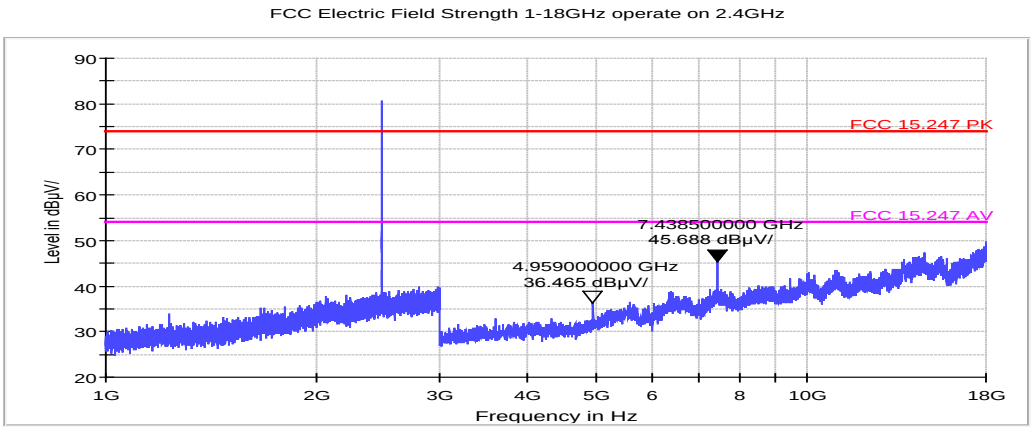
Standard:	FCC Part 15C	Test Distance:	3m
Test item:	Radiated Emission	Power:	AC 120V/60HZ
Model Number:	MIRAGII-N-A	Temp.(℃)/Hum.(%RH):	26(℃)/60%RH
Mode:	Mode 4	Date:	2015/05/21
Frequency:	2480 MHz	Test By:	Fly Lu

Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Polar. H / V
4959	36.47	5.9	42.37	74.0	31.63	peak	H
7438	35.37	6.8	42.17	74.0	31.83	peak	H
4959	30.57	5.9	36.47	74.0	37.53	peak	V
7438	38.89	6.8	45.69	74.0	28.31	peak	V

Horizontal



Vertical



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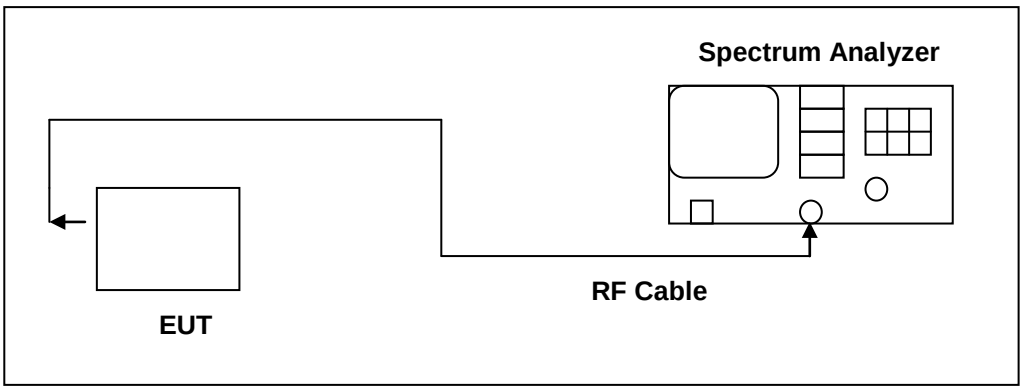
7 20dB RF Bandwidth Measurement

7.1 Limit

N/A

7.2 Test Setup



7.3 Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	N9039A	MY46520256	01/10/2015	2 Years
Test Site	ATL	TE02	TE02	N.C.R.	-----

7.4 Test Procedure

20dB RF Bandwidth

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the inputof the EMC analyzer through a specialized RF connector and a 10dB passiveattenuator. A fully charged battery was used for the supply voltage. The Bluetooth frequency hopping function of the EUT was enabled. Thespectrum analyzer used the following settings:

1. Span = approx. 2 to 3 times the 20dB bandwidth, centered on a hoppingfrequency

2. RBW ⩾ 1% of the 20dB span

3. VBW ⩾ RBW

4. Sweep = auto

5. Detector function = peak

6. Trace = max hold

The trace was allowed to stabilize. The EUT was transmitting at its maximumdata rate. The marker-to-peak function was used to set the marker to the peak ofthe emission. The marker-delta function was used to measure 20dB down oneside of the emission. The marker-delta function and marker was moved to theother side of the

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emission until it was even with the reference marker. Themarker-delta reading at this point was the 20dB bandwidth of the emission.

7.5 Test Result

Model Number	MIRAGII-N-A	
Test Item	20dB RF Bandwidth and 99 % Occupied Bandwidth	
Test Mode	Mode 2: GFSK Link Mode	
Date of Test	2015/05/26	
Frequency (MHz)	20dB RF Bandwidth (MHz)	Limit (MHz)
2402	1.123	-----
2441	1.157	-----
2480	1.242	-----

Model Number	MIRAGII-N-A		
Test Item	20dB RF Bandwidth and 99 % Occupied Bandwidth		
Test Mode	Mode 4: 8DPSK Link Mode		
Date of Test	2015/05/26		
Frequency (MHz)	20dB RF Bandwidth (MHz)		Limit (MHz)
2402	1.324		-----
2441	1.384		-----
2480	1.249		-----

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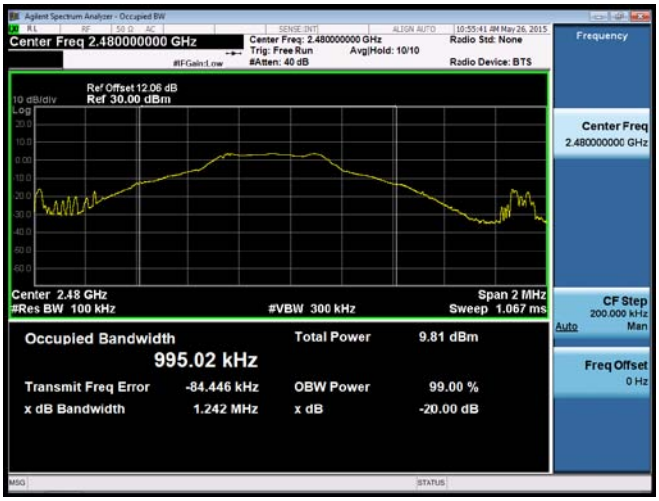
7.6 Test Graphs

Mode 2: GFSK Link Mode	
2402	
2441	
2480	

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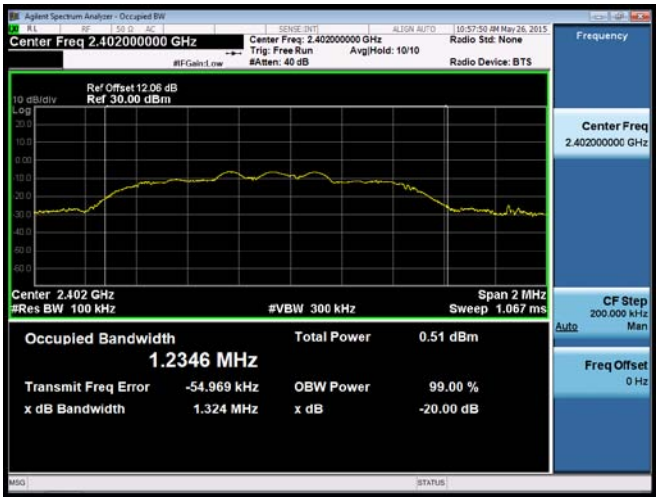
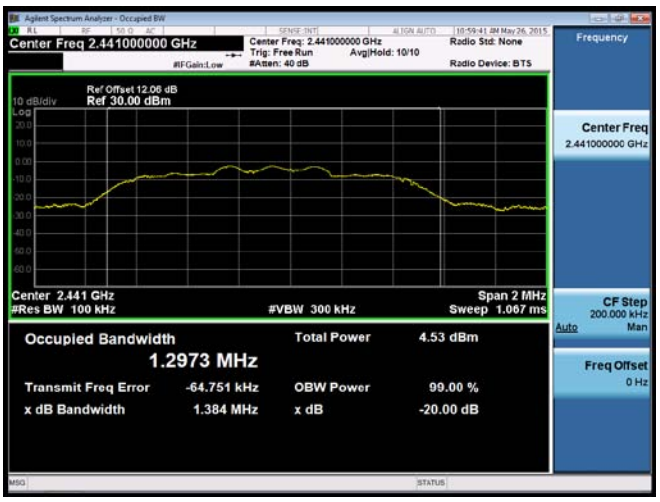
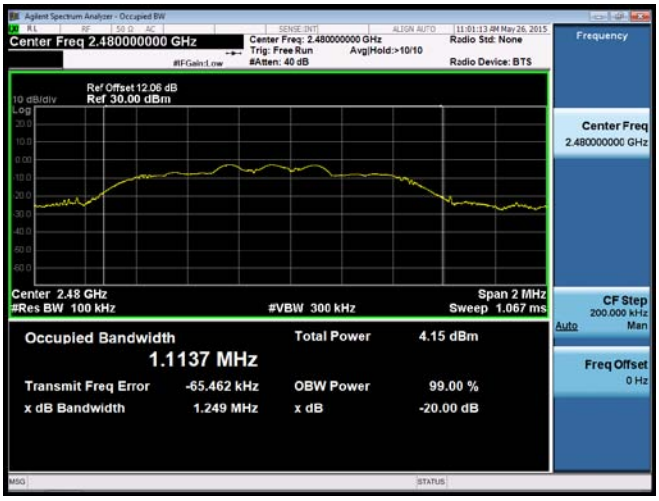
Mode 4: 8DPSK Link Mode	
2402	
2441	
2480	

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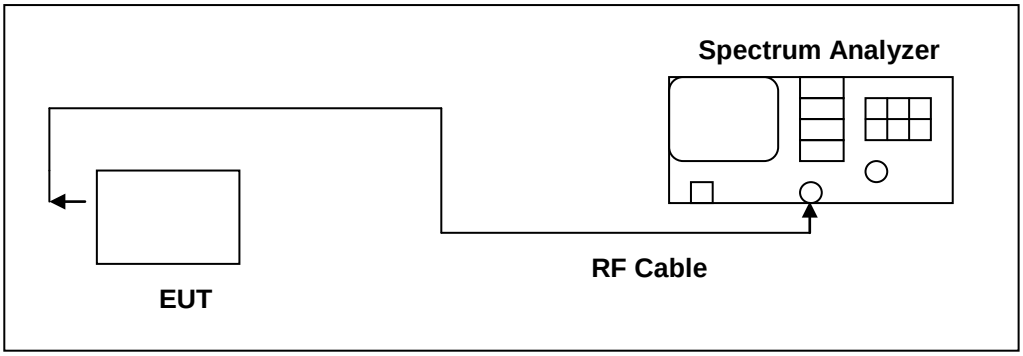
8 Carrier Frequency Separation Measurement

8.1 Limit

Title 47 of the CFR, Part 15 Subpart (c) 15.247(a)(1)(i) requires the measurement of the bandwidth of the transmission between the -20 dB points on the transmitted spectrum. The results of this test determine the limits for channel spacing. The channel spacing shall be a minimum of 25 kHz or the 20 dB bandwidth.

8.2 Test Setup



8.3 Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Signal Analyzer	Agilent	N9020A	MY53420615	12/19/2014	1Year

8.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the inputof the EMC analyzer through a specialized RF connector and a 10dB passiveattenuator. A fully charged battery was used for the supply voltage. The Bluetooth transmitter of the V6 had its hopping function enabled. Thefollowing spectrum analyzer settings were used:

1. Span = wide enough to capture the peaks of two adjacent channels

2. Resolution (or IF) Bandwidth (RBW) ⩾ 1% of the span

3. Video (or Average) Bandwidth (VBW) ⩾ RBW

4. Sweep = auto

5. Detector function = peak

6. Trace = max hold

The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

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8.5 Test Result

Model Number	MIRAGII-N-A	
Test Item	Carrier Frequency Separation	
Test Mode	Mode 2: GFSK Link Mode	
Date of Test	2015/05/26	
Frequency (MHz)	Measurement (MHz)	Limit (MHz)
2441	0.935	>0.832

Model Number	MIRAGII-N-A	
Test Item	Carrier Frequency Separation	
Test Mode	Mode 4: 8DPSK Link Mode	
Date of Test	2015/05/26	
Frequency (MHz)	Measurement (MHz)	Limit (MHz)
2441	0.997	>0.927

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8.6 Test Graphs

Mode 2: GFSK Link Mode	
2441	

Mode 4: 8DPSK Link Mode	
2441	

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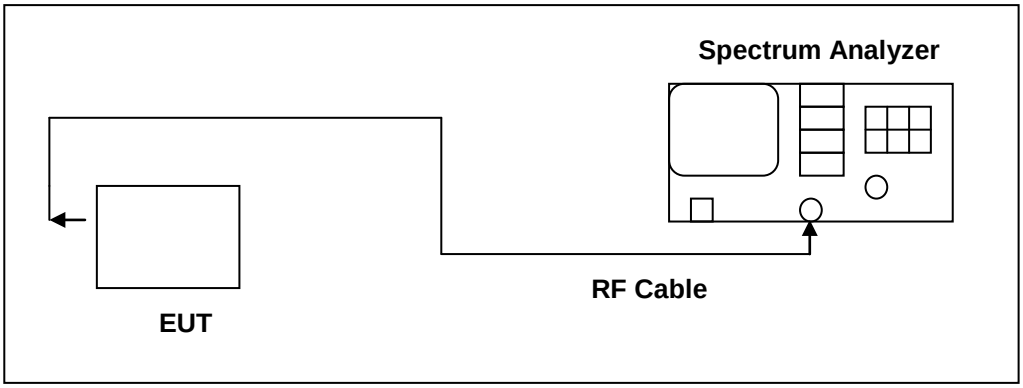
9 Number of Hopping Measurement

9.1 Limit

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

9.2 Test Setup



9.3 Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	N9039A	MY46520256	01/10/2015	2 Years
Test Site	ATL	TE02	TE02	N.C.R.	-----

9.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the inputof the EMC analyzer through a specialized RF connector and a 10dB passiveattenuator. A fully charged battery was used for the supply voltage.The Bluetooth frequency hopping function of the EUT was enabled. Thespectrum analyzer used the following settings:

1. Span = the frequency band of operation
2. RBW ⩾ 1% of the span
3. VBW ⩾ RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

The trace was allowed to stabilize.

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9.5 Test Result

Model Number	MIRAGII-N-A	
Test Item	Number of Hopping	
Test Mode	Mode 2: GFSK Link Mode	
Date of Test	2015/05/26	
Frequency Range (MHz)	Measurement (ch)	Limit (ch)
2402 - 2480	79	> 15

Model Number	MIRAGII-N-A	
Test Item	Number of Hopping	
Test Mode	Mode 4: 8DPSK Link Mode	
Date of Test	2015/05/26	
Frequency Range (MHz)	Measurement (ch)	Limit (ch)
2402 - 2480	79	> 15

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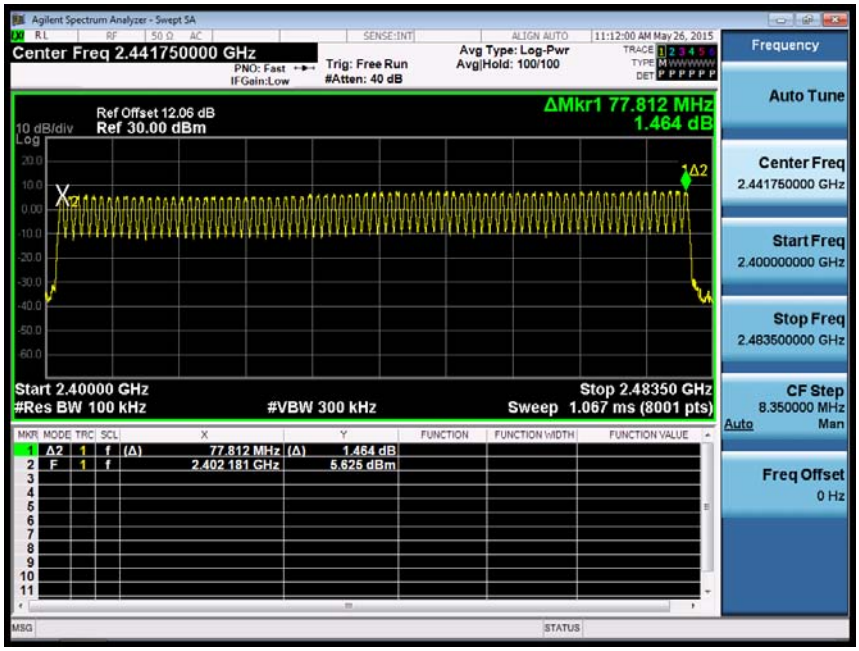
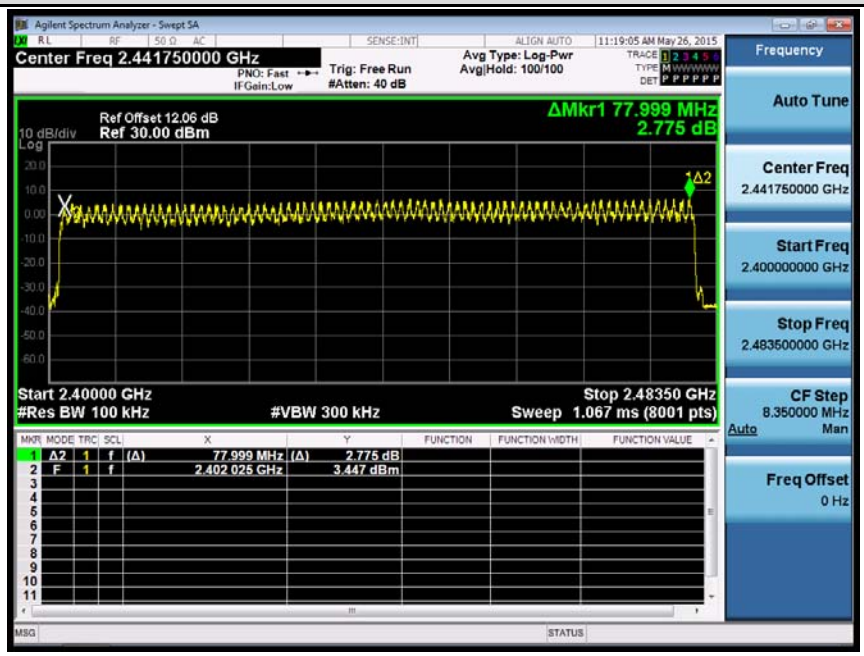
9.6 Test Graphs

Mode 2: GFSK Link Mode



Mode 4: 8DPSK Link Mode

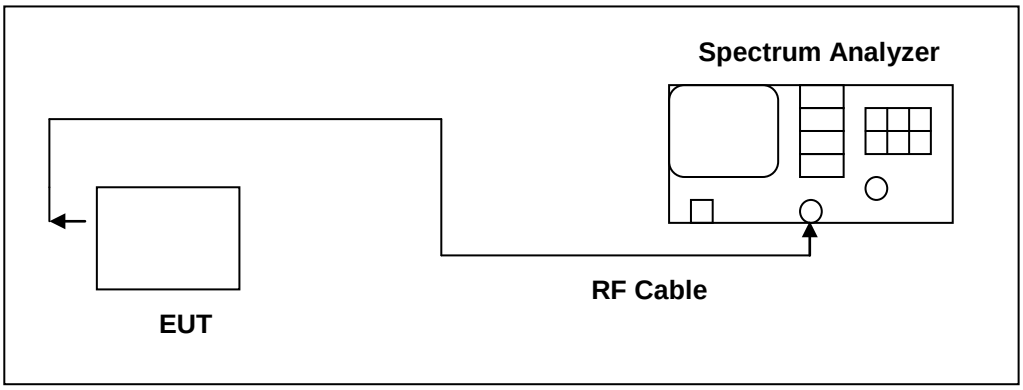


10 Time of Occupancy (Dwell Time) Measurement

10.1 Limit

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

10.2 Test Setup



10.3 Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	N9039A	MY46520256	01/10/2015	2 Years
Test Site	ATL	TE02	TE02	N.C.R.	-----

10.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The RF output port of the Equipment-Under-Test is directly coupled to the inputof the EMC analyzer through a specialized RF connector and a 10dB passiveattenuator. A fully charged battery was used for the supply voltage. The Bluetooth hopping function of the EUT was enabled. The following spectrumanalyzer settings were used:

1. Span = zero span, centered on a hopping channel
2. RBW = 1 MHz
3. VBW ⩾ RBW
4. Sweep = as necessary to capture the entire dwell time per hoppingchannel
5. Detector function = peak
6. Trace = max hold

The marker-delta function was used to determine the dwell time.

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10.5 Test Result

Model Number	MIRAGII-N-A
Test Item	Time of Occupancy (Dwell Time)
Test Mode	Mode 2: GFSK Link Mode
Date of Test	2015/06/19
DH1	
Length of per burst(ms)	0.4213
Number of burst in 5 seconds	51
Cycle Calculate	79CH * 0.4 = 31.6 (sec)
Dwell Times	31.6/5*51*0.4213 =135.793
LIMIT(msec)	< = 400
DH3	
Length of per burst(ms)	1.707
Number of burst in 5 seconds	27
Cycle Calculate	79CH * 0.4 = 31.6 (sec)
Dwell Times	31.6/5*25*1.707 =269.706
LIMIT(msec)	< = 400
DH5	
Length of per burst(ms)	2.955
Number of burst in 5 seconds	18
Cycle Calculate	79CH * 0.4 = 31.6 (sec)
Dwell Times	31.6/5*17*2.955 =336.161
LIMIT(msec)	< = 400

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Model Number	MIRAGII-N-A
Test Item	Time of Occupancy (Dwell Time)
Test Mode	Mode 4: 8DPSK Link Mode
Date of Test	2015/06/19
DH1	
Length of per burst(ms)	0.438
Number of burst in 5 seconds	51
Cycle Calculate	79CH * 0.4 = 31.6 (sec)
Dwell Times	31.6/5*51*0.438 =141.176
LIMIT(msec)	< = 400
DH3	
Length of per burst(ms)	1.695
Number of burst in 5 seconds	26
Cycle Calculate	79CH * 0.4 = 31.6 (sec)
Dwell Times	31.6/5*25*1.695 =278.522
LIMIT(msec)	< = 400
DH5	
Length of per burst(ms)	2.970
Number of burst in 5 seconds	18
Cycle Calculate	79CH * 0.4 = 31.6 (sec)
Dwell Times	31.6/5*17*2.970 =337.867
LIMIT(msec)	< = 400

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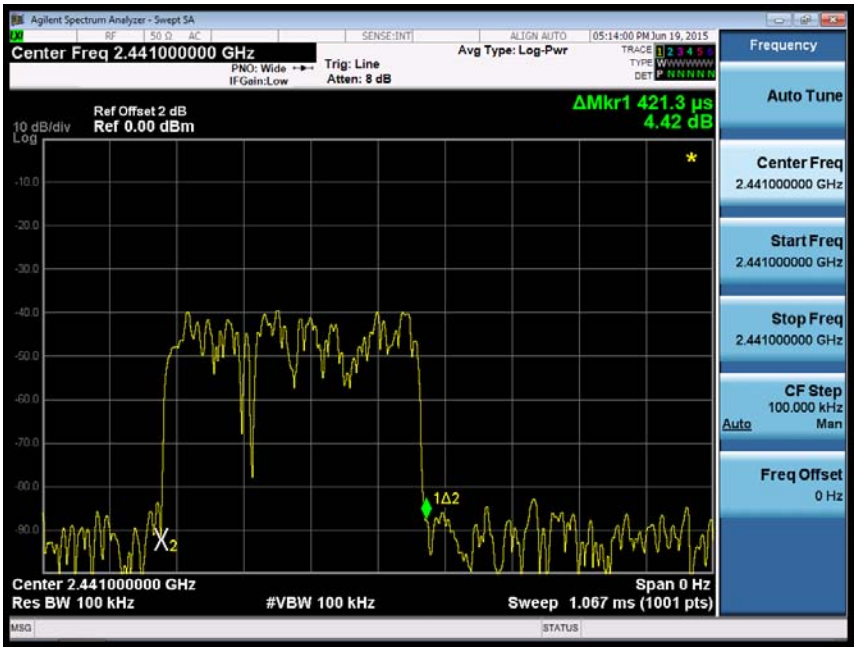
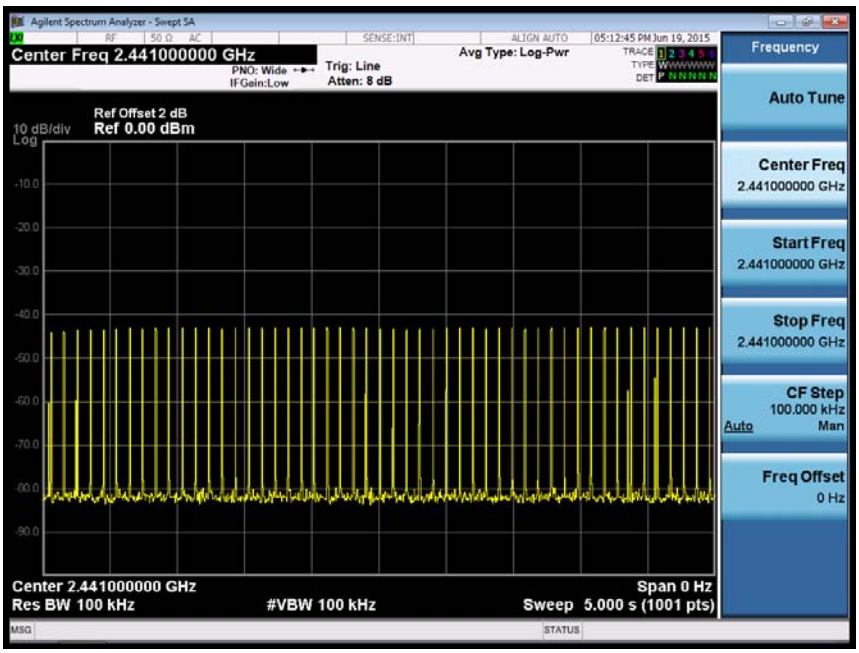
10.6 Test Graphs

Mode 2: GFSK Link Mode	
DH1	
	

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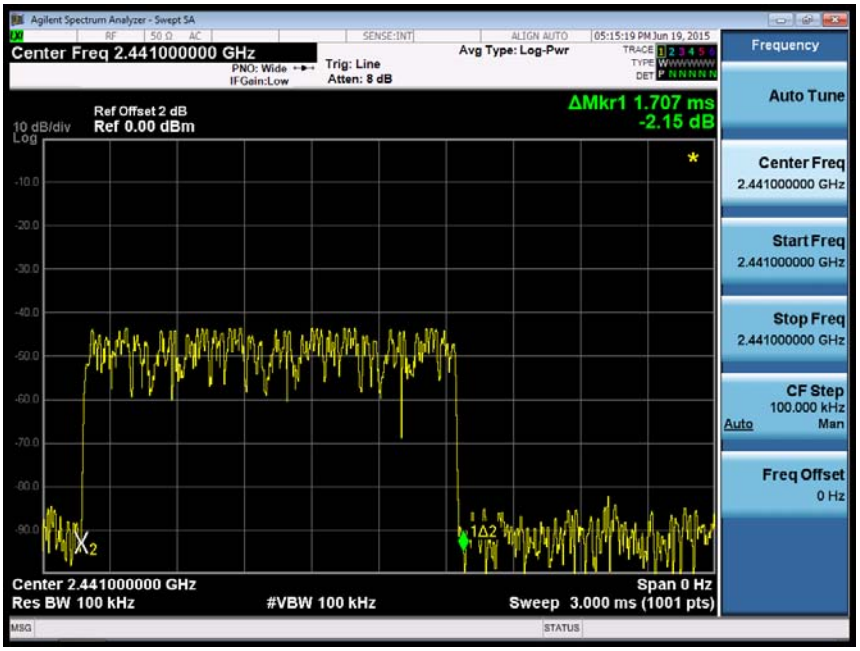
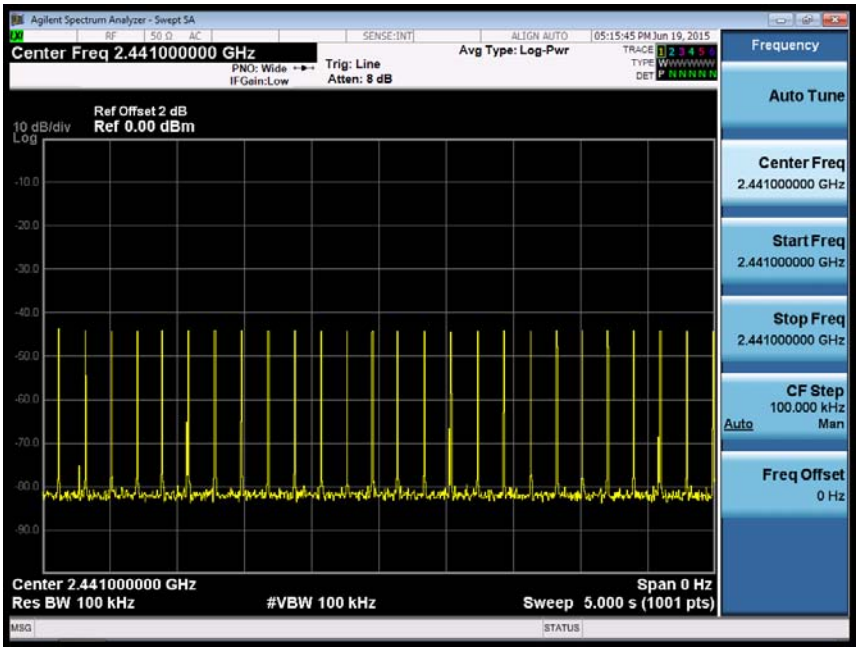
Mode 2: GFSK Link Mode	
DH3	 

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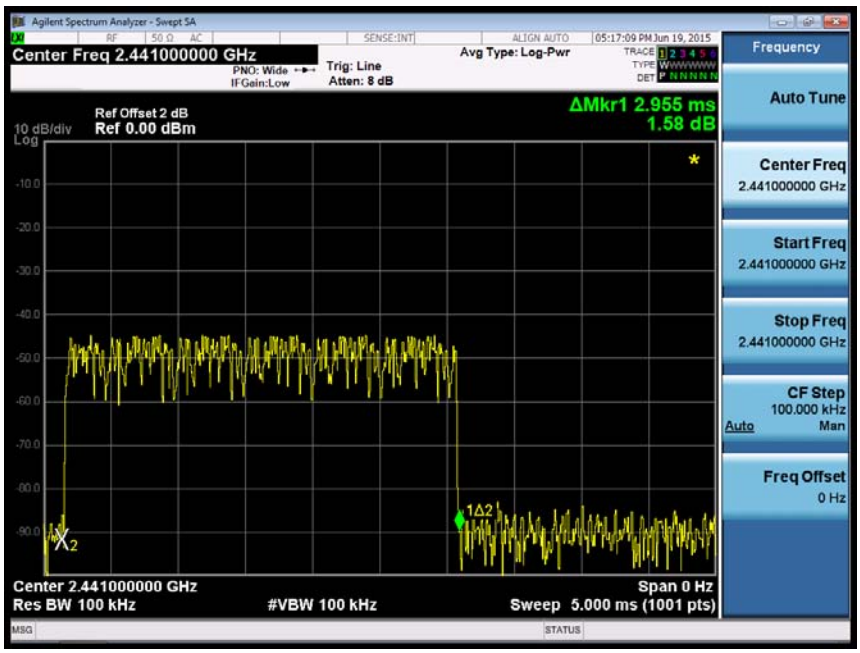
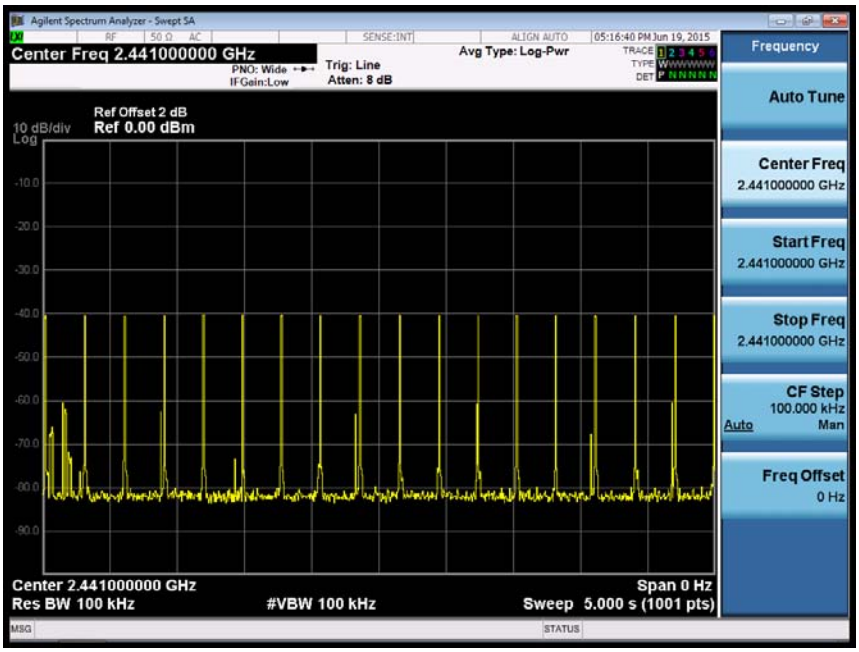
Mode 2: GFSK Link Mode	
DH5	
	

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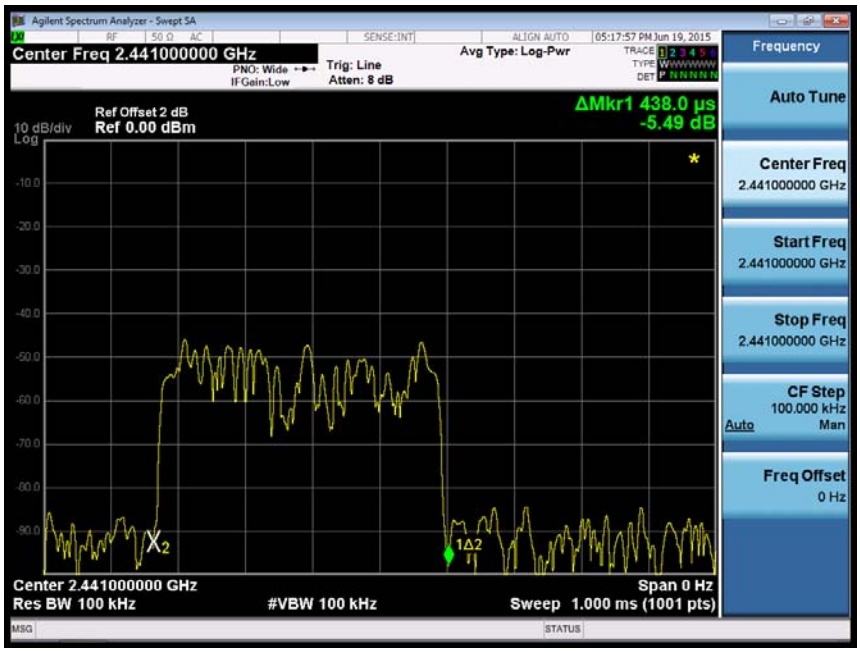
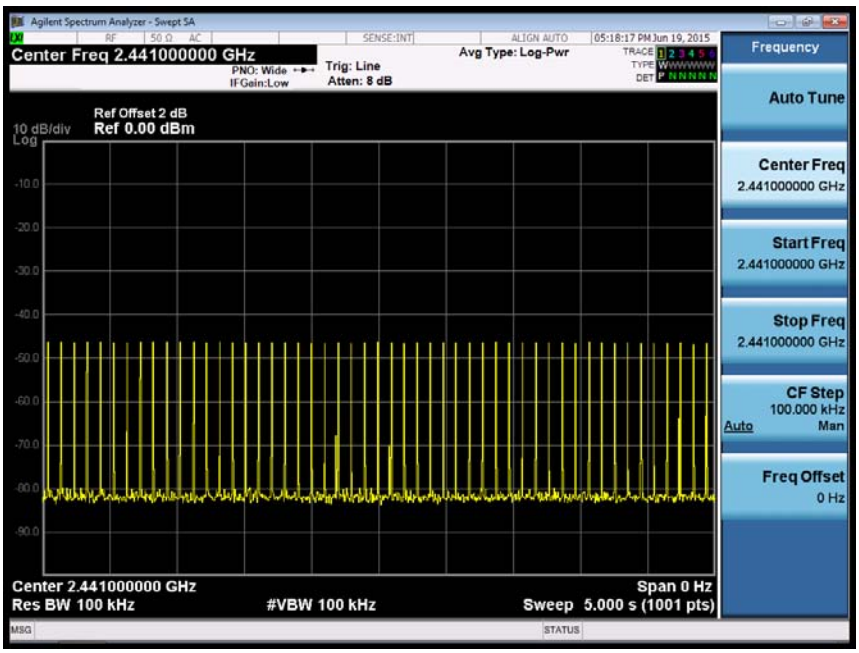
Mode 4: 8DPSK Link Mode	
3-DH1	 

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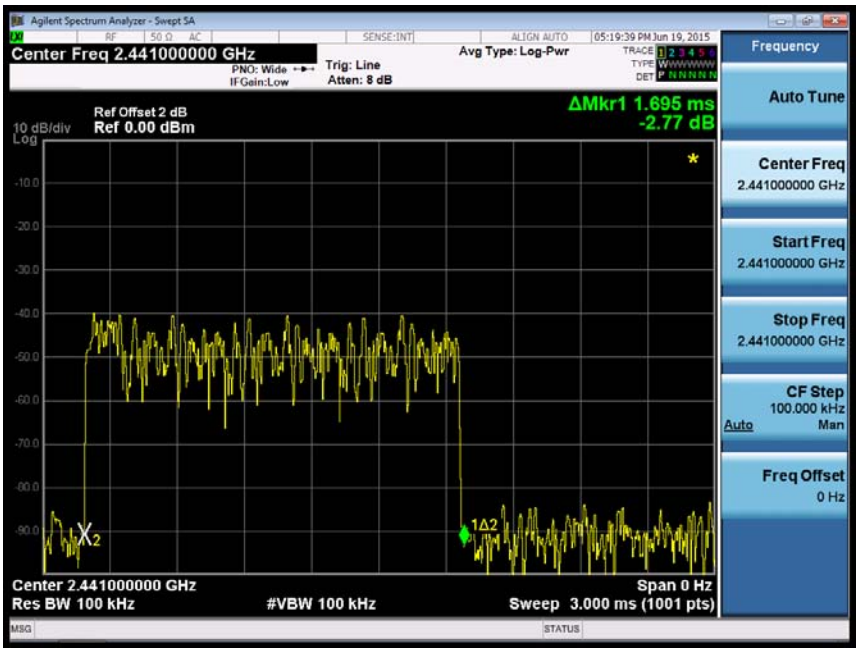
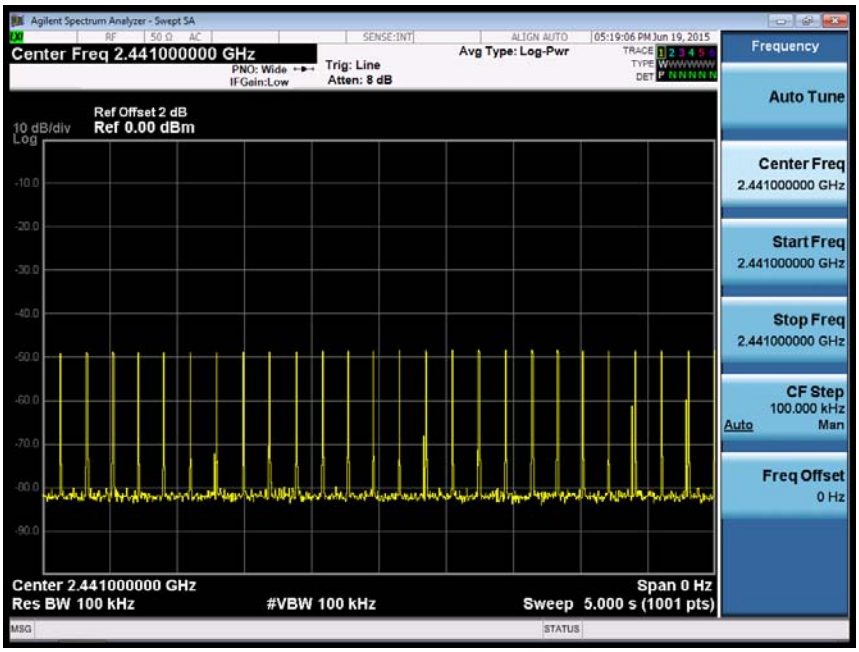
Mode 4: 8DPSK Link Mode	
3-DH3	 

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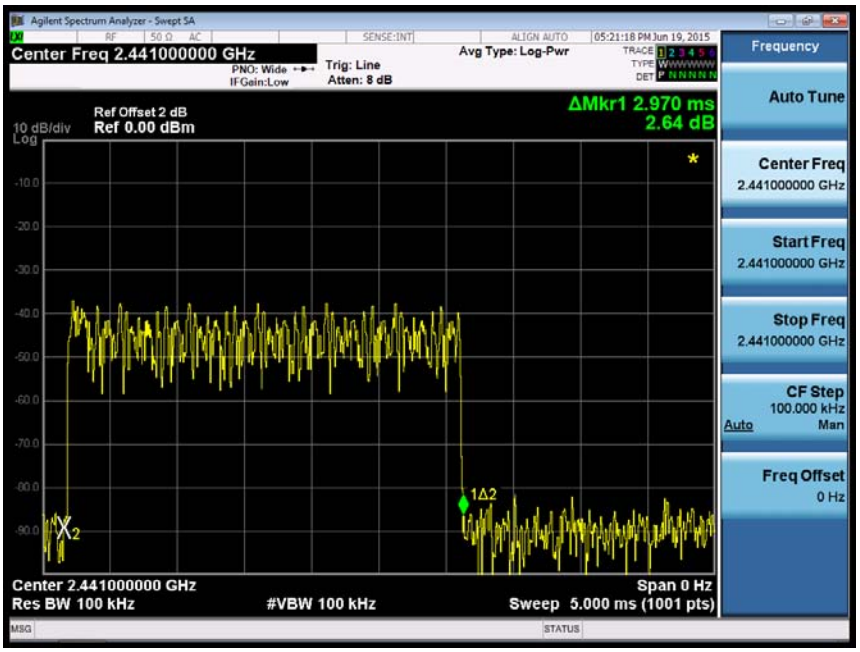
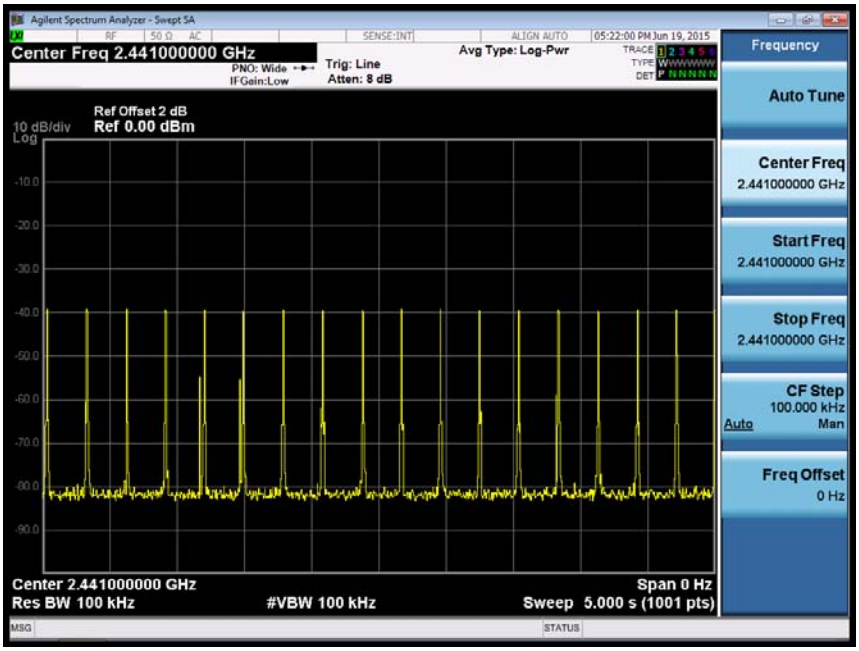
Mode 4: 8DPSK Link Mode	
3-DH5	
	

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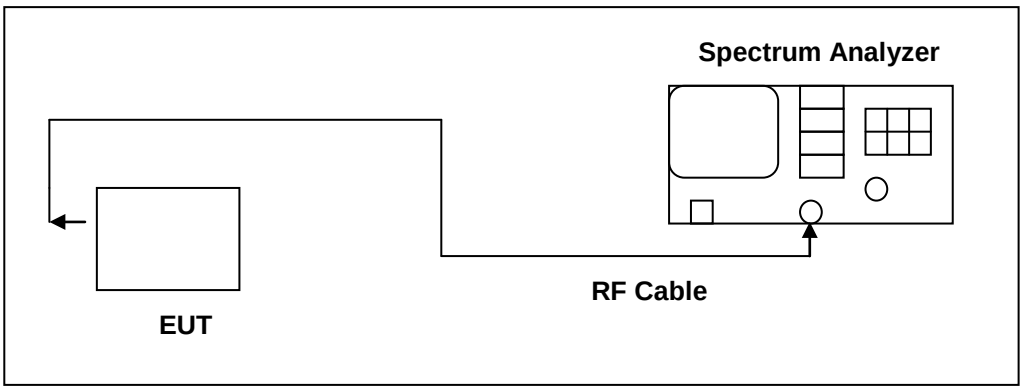
11 Out of Band Conducted Emissions Measurement

11.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

11.2 Test Setup



11.3 Test Instruments

Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Remark
Spectrum Analyzer	Agilent	N9039A	MY46520256	01/10/2015	2 Years
Test Site	ATL	TE02	TE02	N.C.R.	-----

11.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band. The test was performed at 3 channels (Channel 0, 39, 78)

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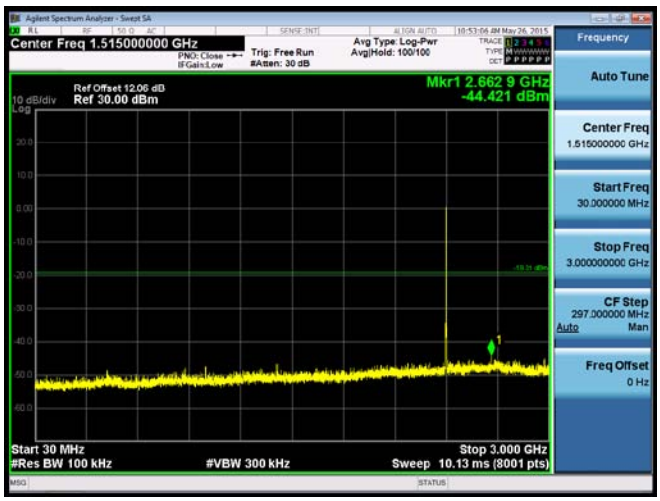
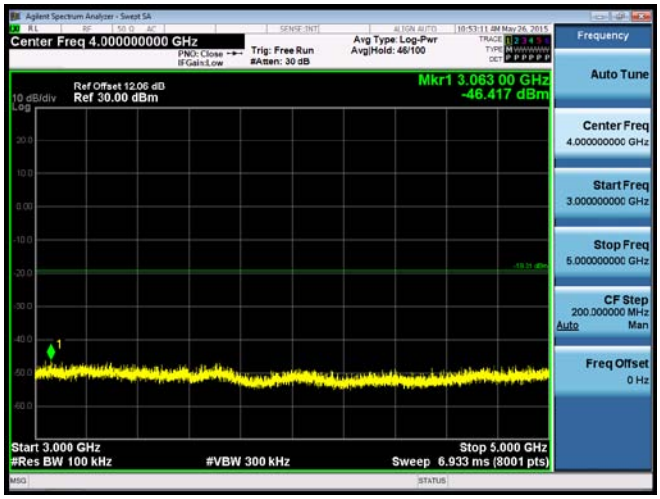
11.5 Test Graphs

Mode 2 :GFSK Link Mode 2402MHz	
Limit to confirm	
30MHz-3GHz	
3GHz-5GHz	

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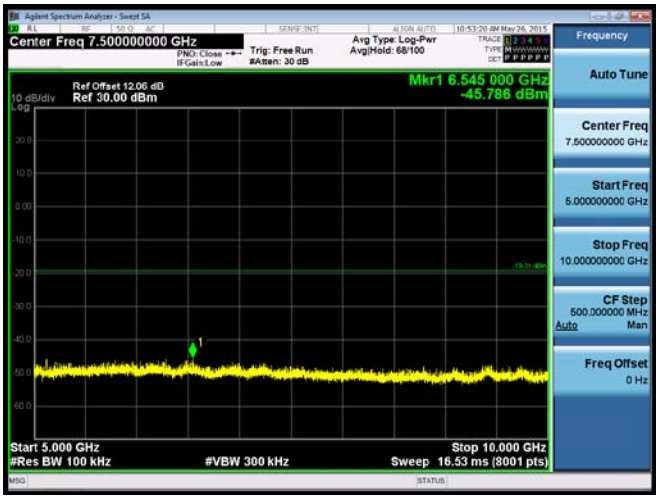
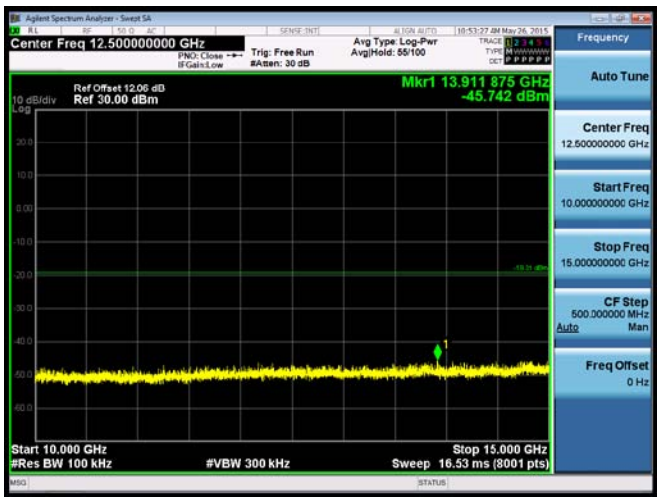
5GHz-10GHz	
10GHz-15GHz	
15GHz-25GHz	

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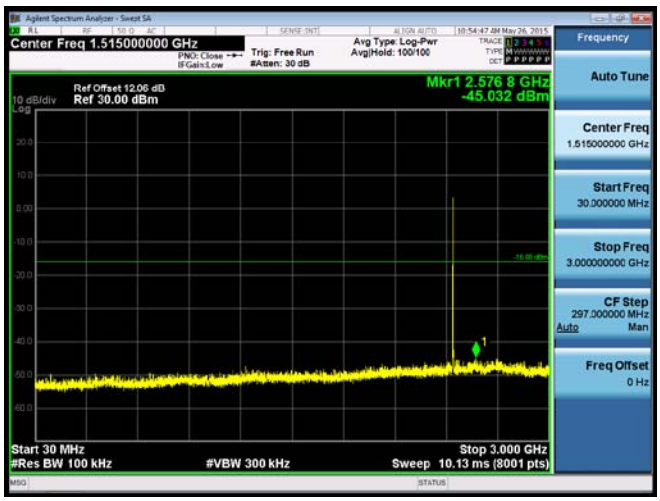
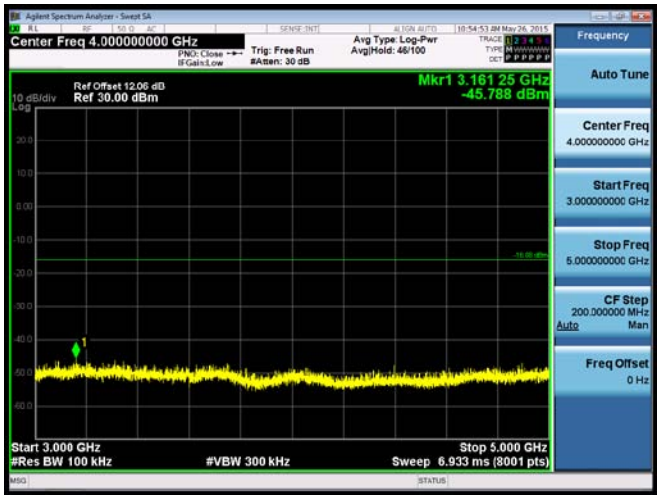
Mode 2 :GFSK Link Mode 2441MHz	
Limit to confirm	
30MHz-3GHz	
3GHz-5GHz	

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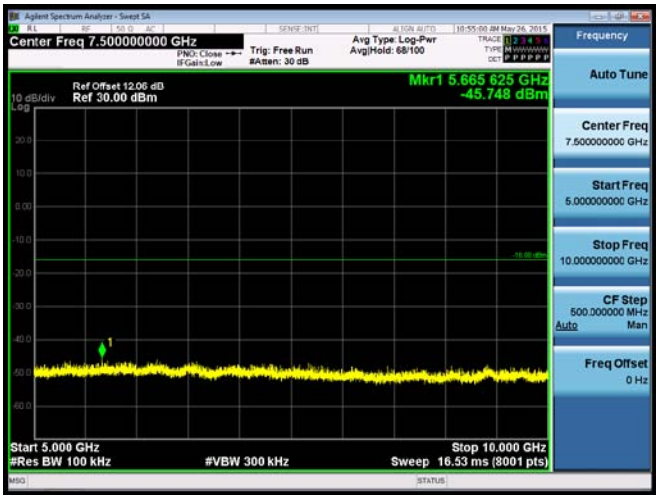
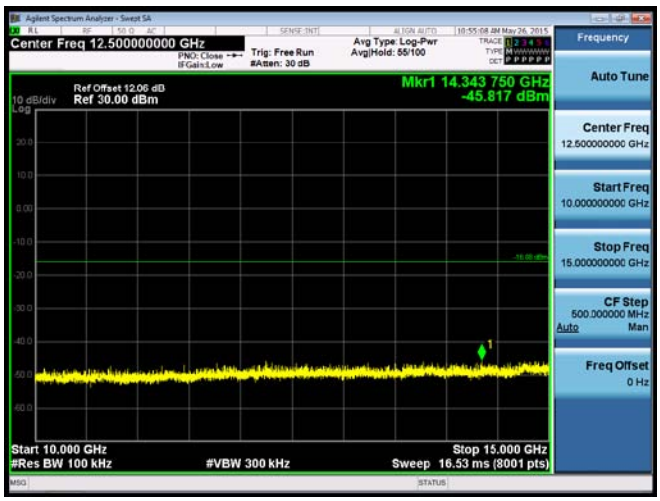
5GHz-10GHz	
10GHz-15GHz	
15GHz-25GHz	

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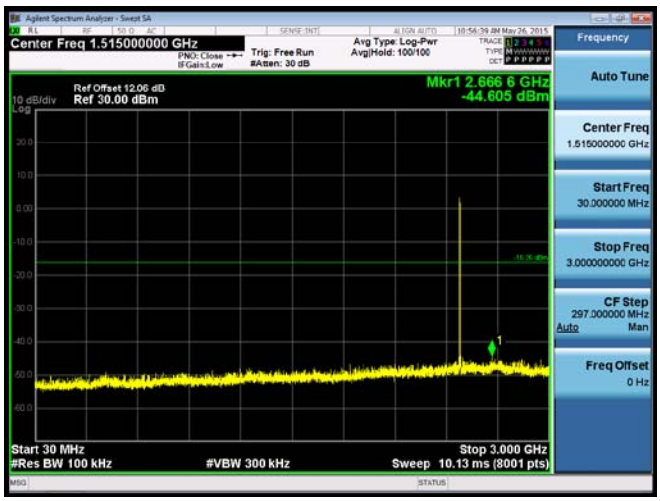
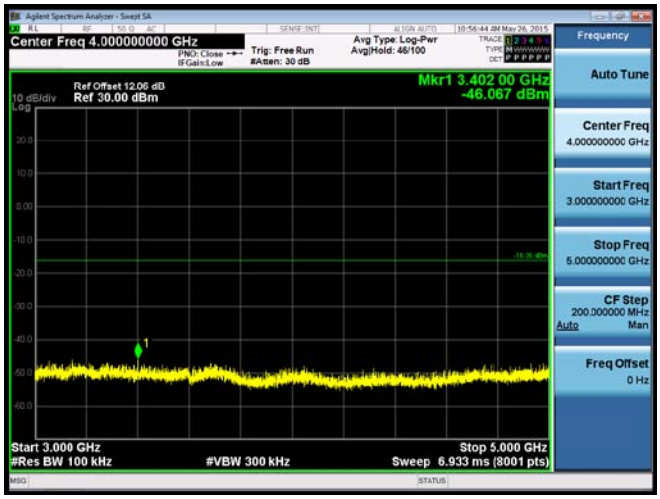
Mode 2 :GFSK Link Mode 2480MHz	
Limit to confirm	
30MHz-3GHz	
3GHz-5GHz	

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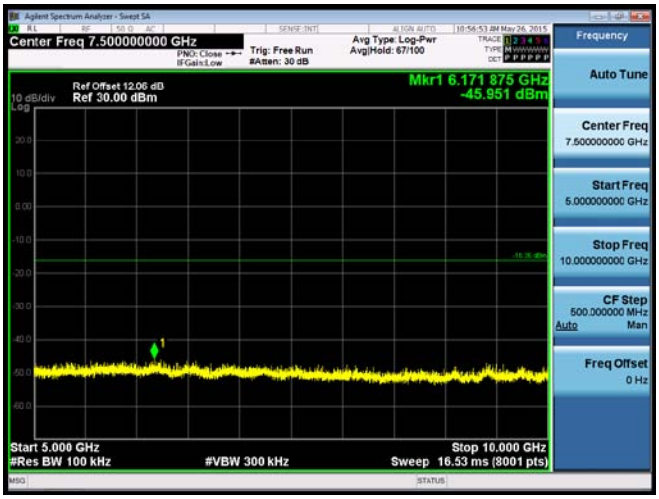
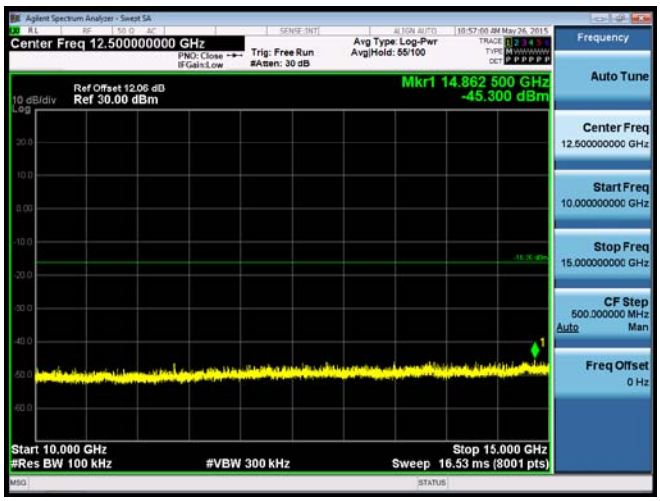
5GHz-10GHz	
10GHz-15GHz	
15GHz-25GHz	

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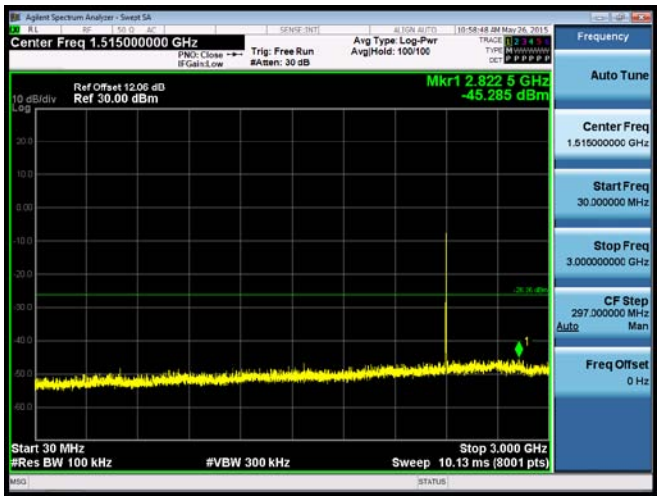
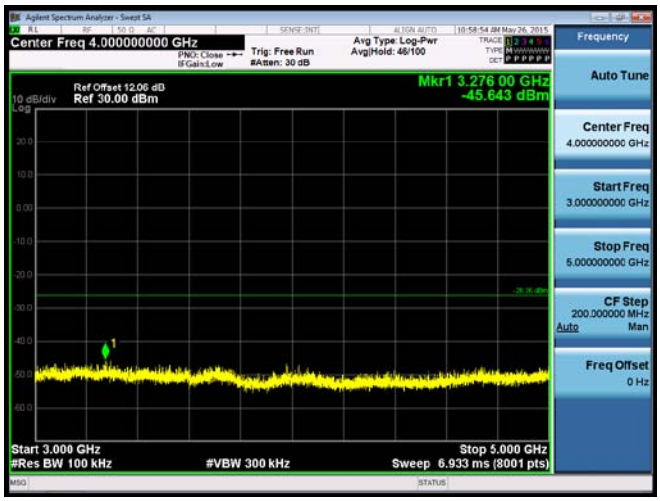
Mode 4 :8DPSK Link Mode 2402MHz	
Limit to confirm	
30MHz-3GHz	
3GHz-5GHz	

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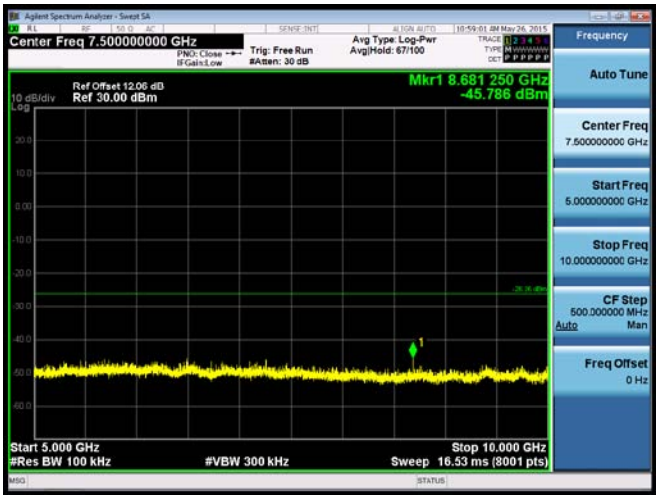
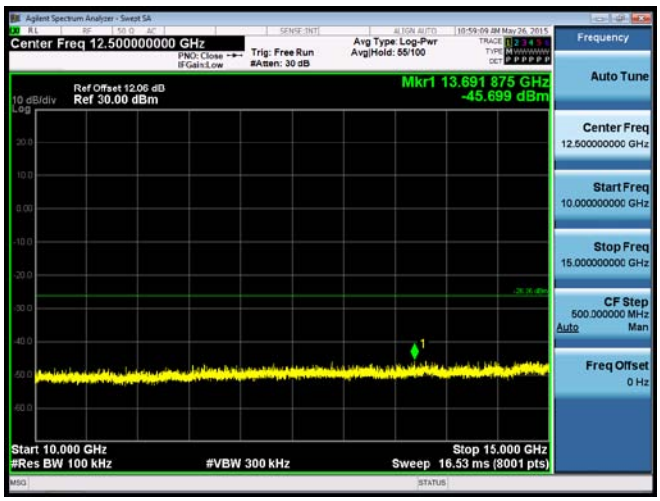
5GHz-10GHz	
10GHz-15GHz	
15GHz-25GHz	

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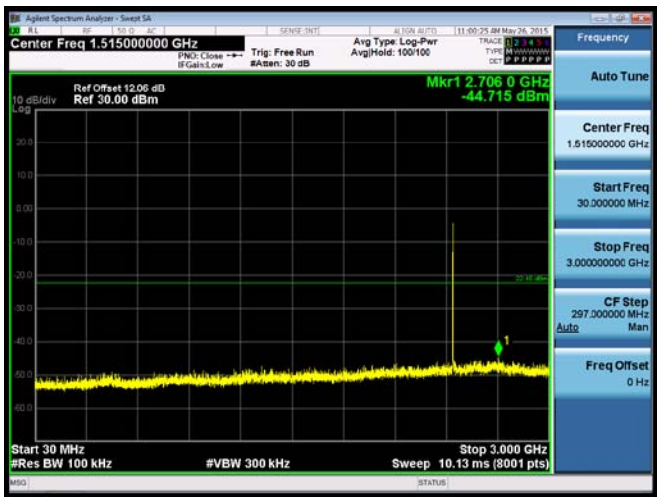
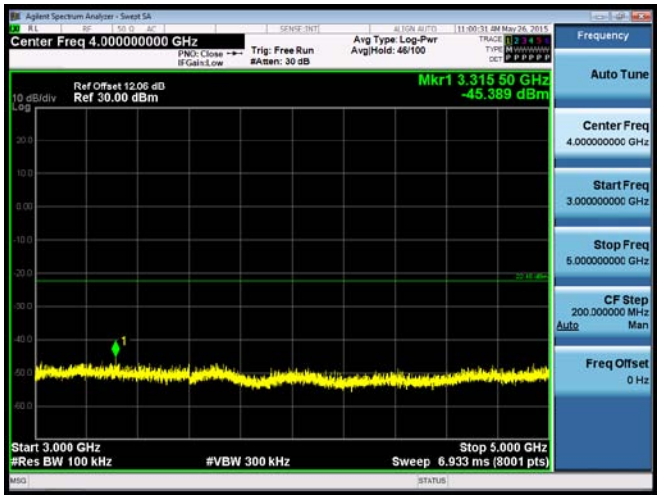
Mode 4 :8DPSK Link Mode 2441MHz	
Limit to confirm	
30MHz-3GHz	
3GHz-5GHz	

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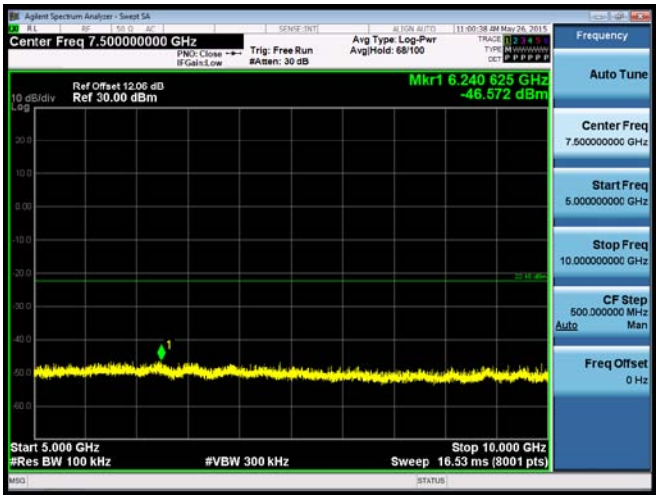
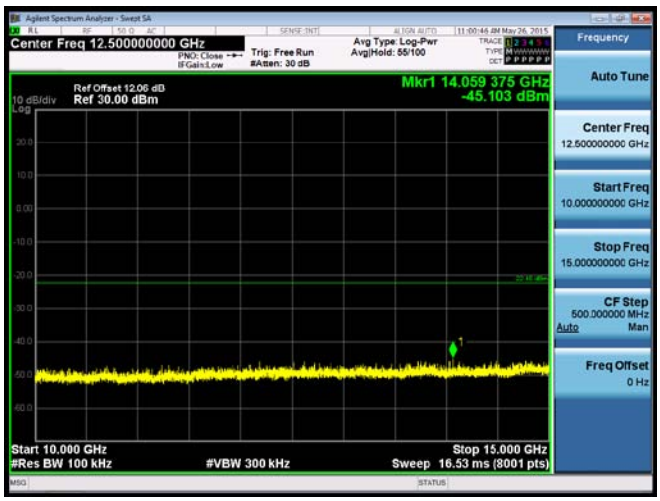
5GHz-10GHz	
10GHz-15GHz	
15GHz-25GHz	

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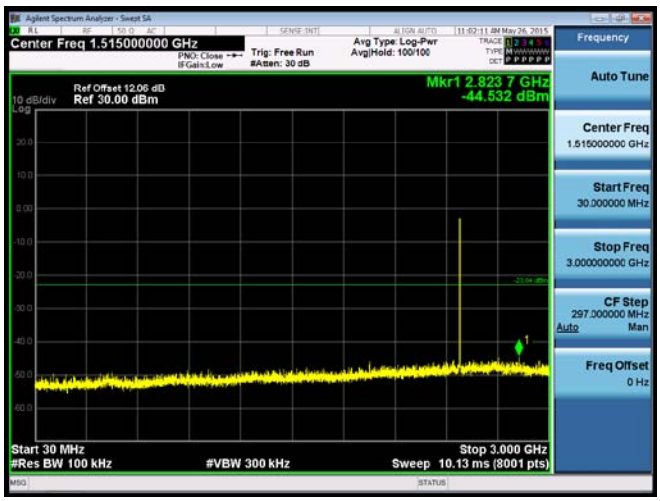
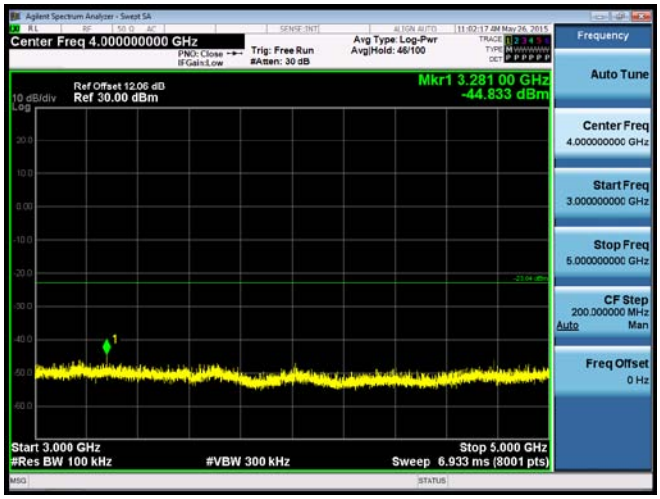
Mode 4 :8DPSK Link Mode 2480MHz	
Limit to confirm	
30MHz-3GHz	
3GHz-5GHz	

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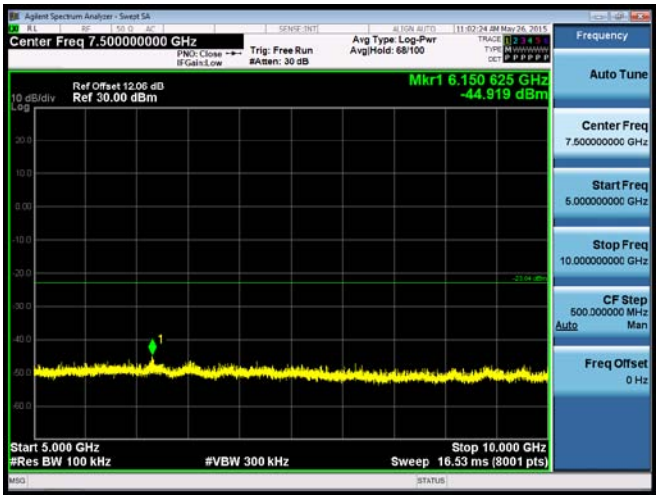
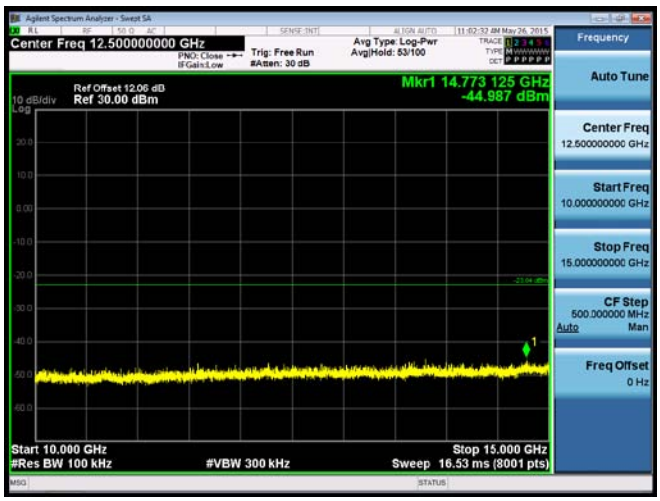
5GHz-10GHz	
10GHz-15GHz	
15GHz-25GHz	

Note: No emission found between lowest internal used/generated frequencies to 30MHz (9 kHz~30MHz).

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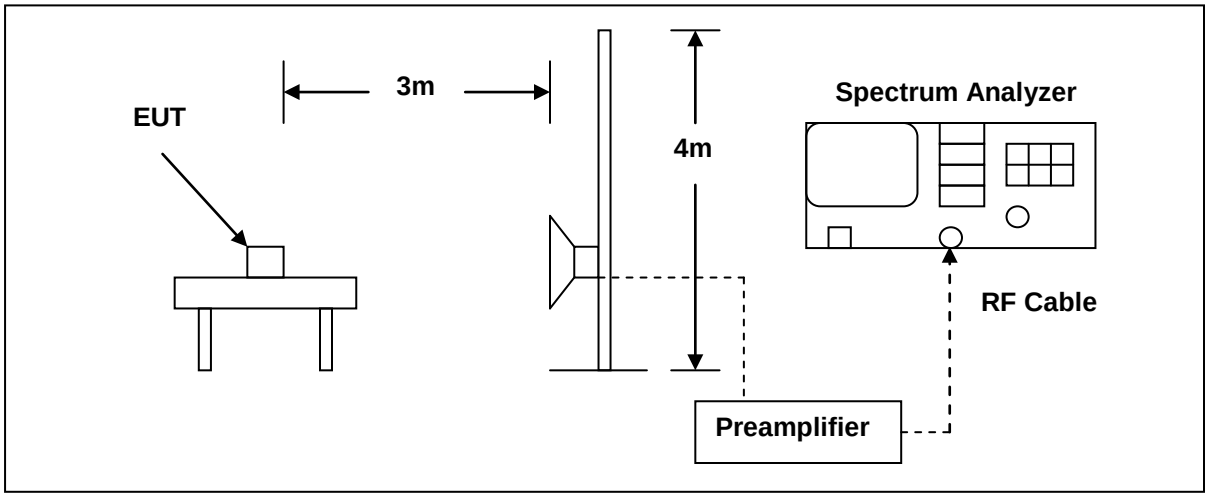
12 Band Edges Measurement

12.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

12.2 Test Setup



12.3 Test Instruments

3 Meter Chamber					
Model No.	Equipment	Manufacturer	Serial Number	Cal. Date	Remark
ESU40	EMI Test Receiver	R&S	SB8501/09	May.16, 2015	1 Year
VULB9163	Bilog Antenna	Schwarzbeck	SB8501/04	Jan.20, 2015	1 Year
HF906	Horn Antenna	R&S	SB3435	Jan.20, 2015	1 Year
--	Amplifier(1-18GHz)	R&S	SB3435/01	Jan.20, 2015	1 Year
--	Amplifier(18-40GHz)	R&S	SB3435/02	May.16, 2015	1 Year
AT4560	Horn Antenna	Amplifier Research	SB5392/02	May.16, 2015	1 Year
9X6X6	3m Semi-anechoic chamber	Albatross Projects	SB3450/01	Oct.12, 2013	2 Years
ESI26	EMI Test Receiver	Rohde & Schwarz	SB3436	Jan.20,2015	1 Year
VULB9163	Broadband antenna	SCHWARZBECK	SB3955	Jan.20,2015	1 Year

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HF907	Horn Antenna	R&S	SB8501/01	Aug.15,2014	1 Year
Spectrum Analyzer	Agilent	N9039A	MY46520256	Jan.10, 2015	2 Years

12.4 Test Procedure

Testing must be done according to this procedure, FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. This is the only method recognized by the FCC. The emissions on the harmonics frequencies, the limits, and the margin of compliance are presented. These tests were made when the transmitter was in full radiated power. The additional test was performed to show compliance with the requirement at the band-edge frequency 2483.5 MHz and up to 2500 MHz and at 2390.0 MHz

The transmitter was configured with the worst case antenna and setup to transmit at the highest channel. Then the field strength was measured at 2483.5 MHz

The transmitter was then configured with the worst case antenna and setup to transmit at the lowest channel. Then the field strength was measured at 2390.0 MHz these tests were performed at 4 different bit rates.

For measurements the resolution bandwidth is set to 1 MHz, and then the video bandwidth is setto 1 MHz for peak measurements and 10 Hz for average measurements.

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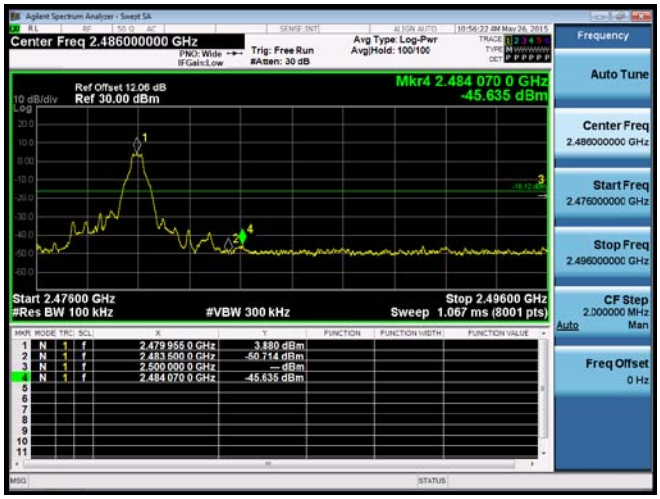
12.5 Test Result

Conducted Band Edge

Mode 2: GFSK Link Mode	
2402 No-Hopping	
2480No-Hopping	

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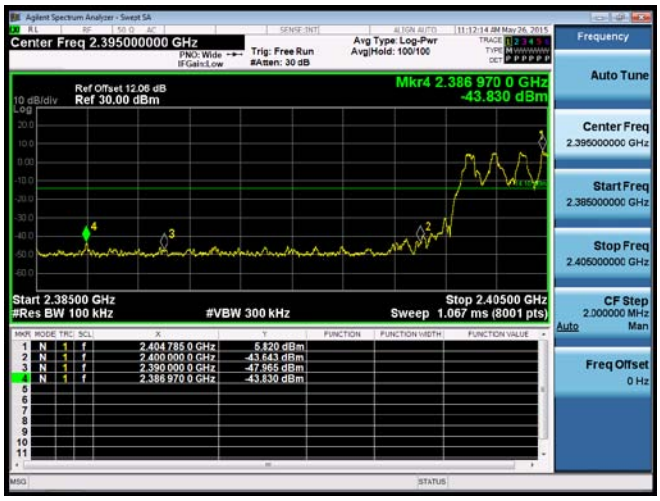
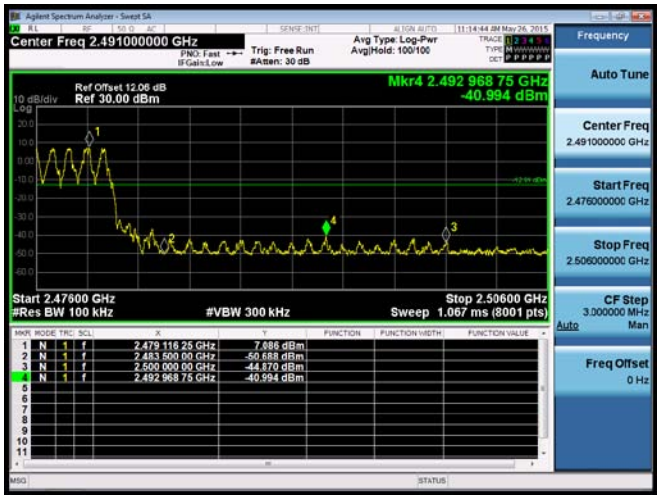
Mode 2: GFSK Link Mode	
2402 Hopping	
2480Hopping	

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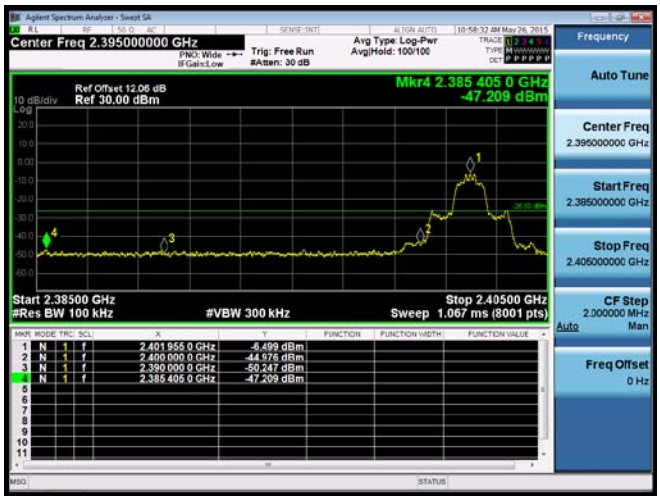
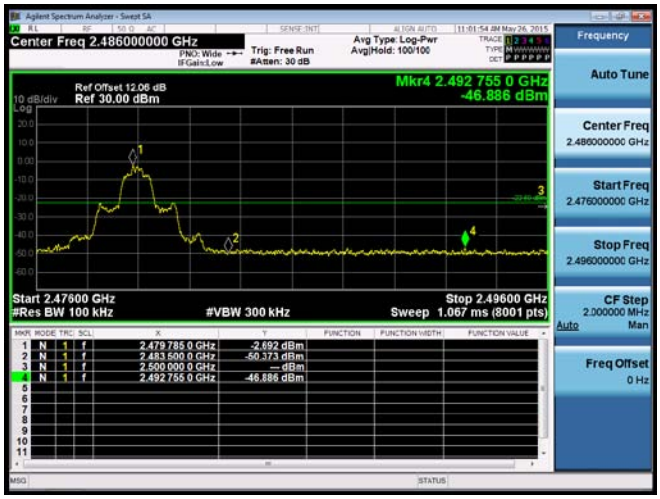
Mode 4:8DPSK Link Mode	
2402 No-Hopping	
2480No-Hopping	

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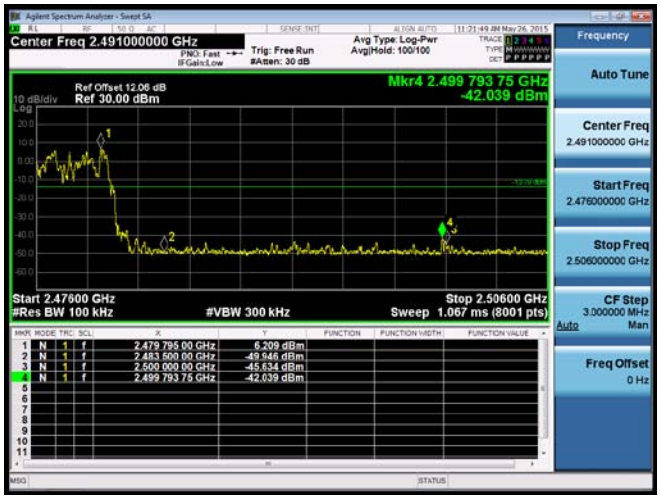
Mode 4: 8DPSK Link Mode	
2402 Hopping	
2480Hopping	

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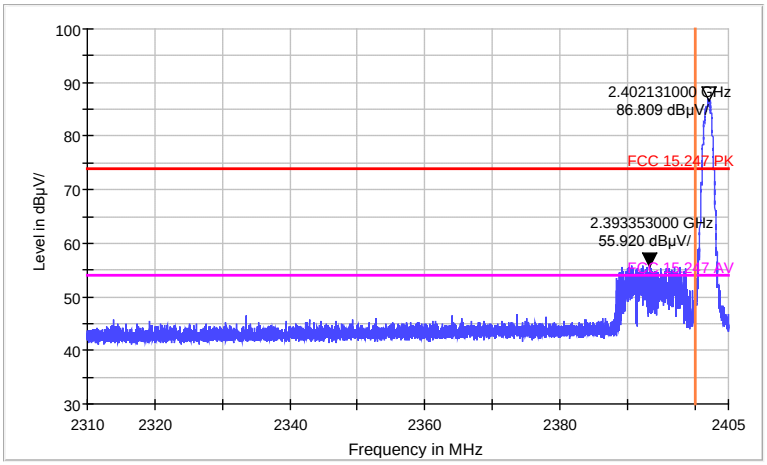
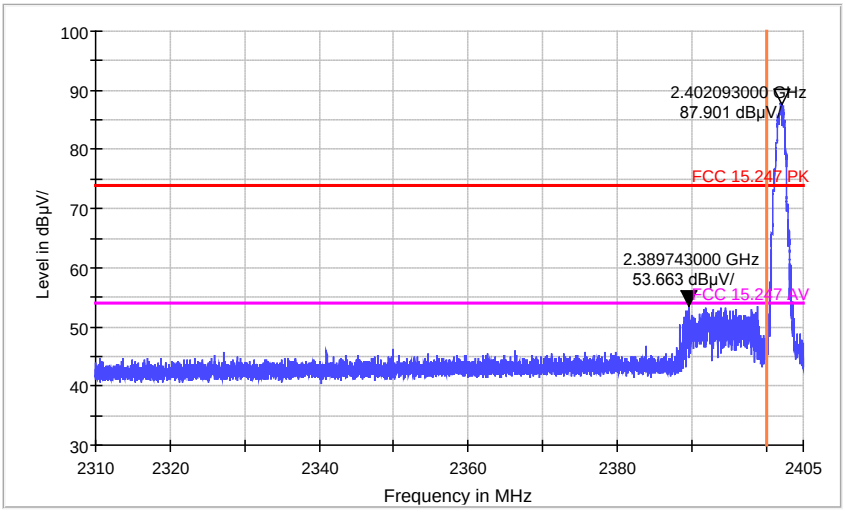
Radiated Band Edgespuriousemission

Mode4:GFKSLink Mode

2402/H



2402/V



Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Remark
2393.5	55.92	74	17.98	H	Peak
2393.5	45.73	54	8.27	H	Average
2389.7	53.66	74	15.29	V	Peak
--	--	--	--	--	Average

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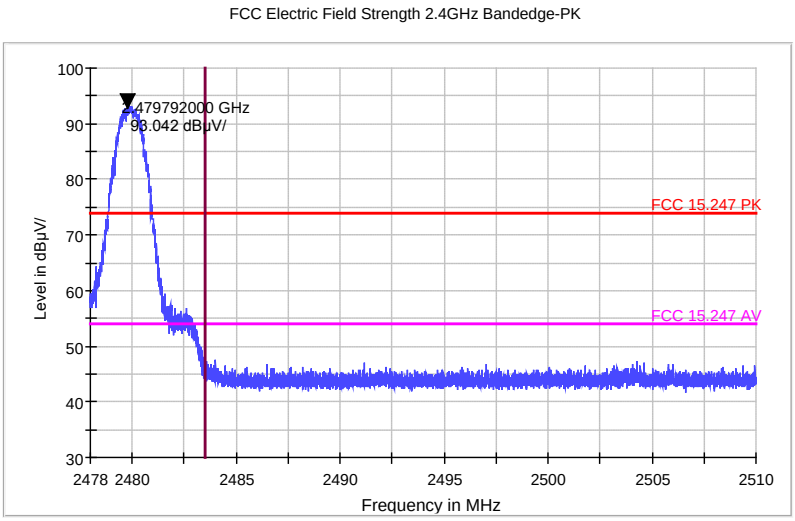
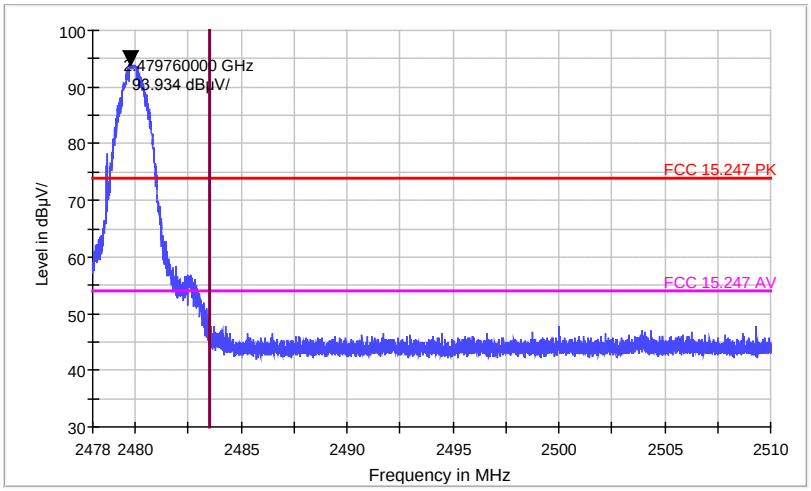
Mode4:GFKSLink Mode

2480/H



2480/V



Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Remark
2483.5	51.22	74	22.78	H	Peak
--	--	--	--	--	Average
2483.5	49.92	74	24.08	V	Peak
--	--	--	--	--	Average

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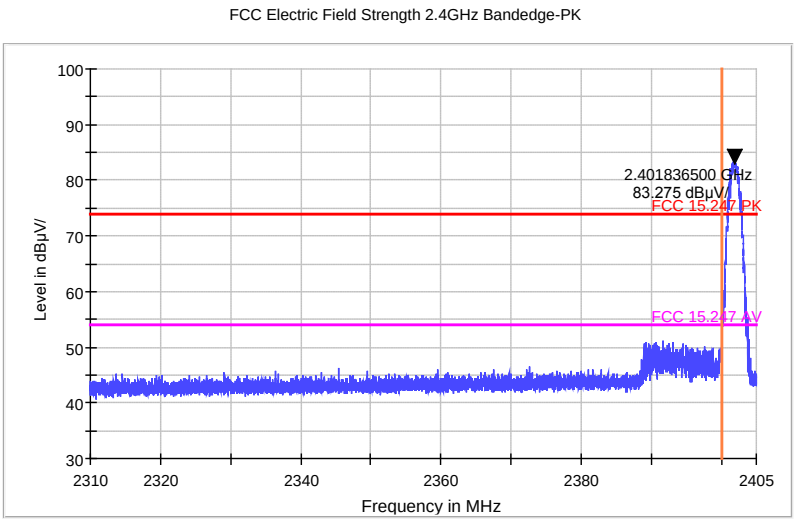
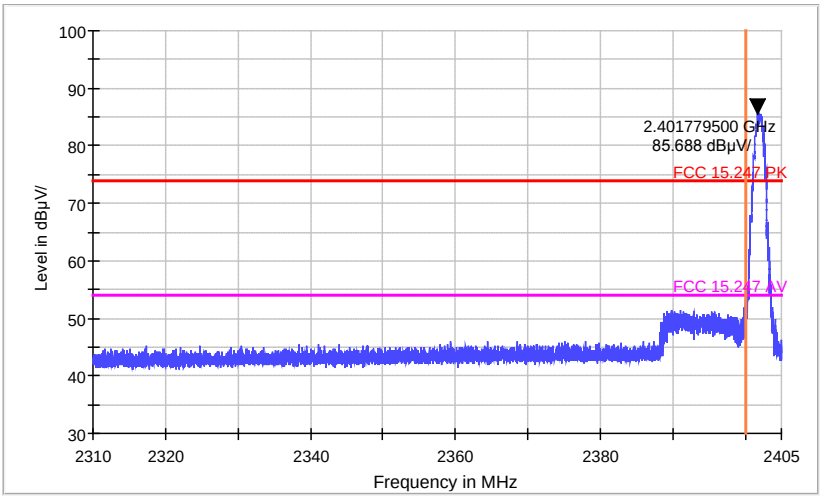
Mode4:8DPSK Link Mode

2402/H



2402/V



Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Remark
2399.2	52.08	74	21.92	H	Peak
--	--	--	--	--	Average
2390.1	53.05	74	20.95	V	Peak
--	--	--	--	--	Average

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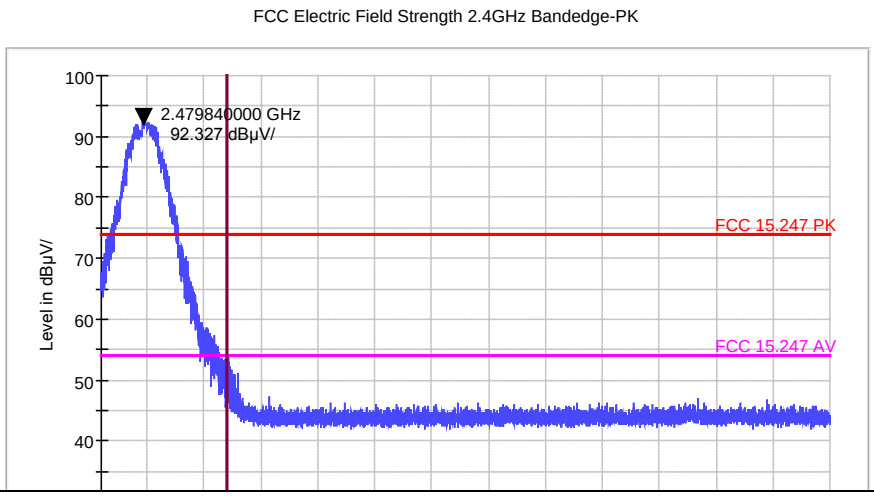
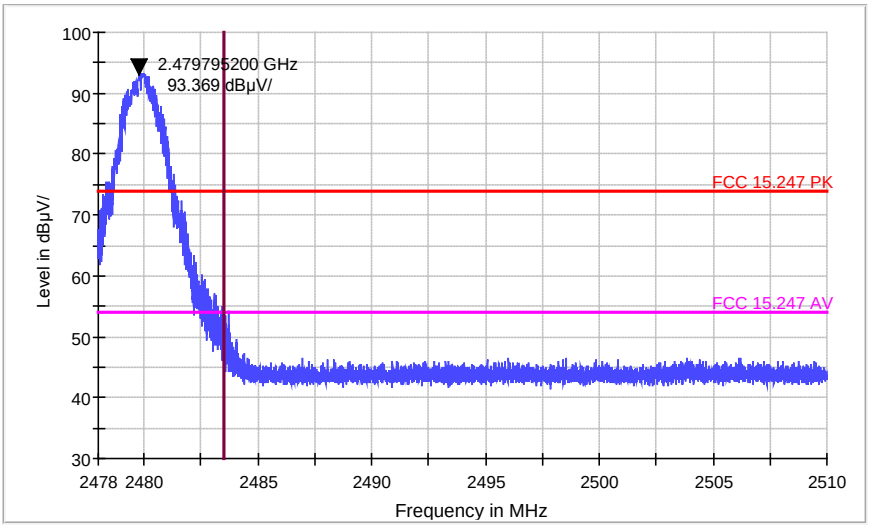
Mode4:8DPSK Link Mode

2480/H



2480/V



Frequency (MHz)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Remark
2483.5	55.12	74	18.88	H	Peak
2483.5	44.93	54	9.07	H	Average
2483.5	53.71	74	28.25	V	Peak
--	--	--	--	--	Average

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13 Antenna Measurement

13.1 Limit

For intentional device, according to 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

13.2 AntennaConnector Construction

The antenna used in this product isinternalPCB antenna. And the maximum Gain of this antenna is 0.5dBi.

----------The End----------

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